



This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

### Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

- + *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.
- + *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.
- + *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.
- + *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

### About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at <http://books.google.com/>

T D

678

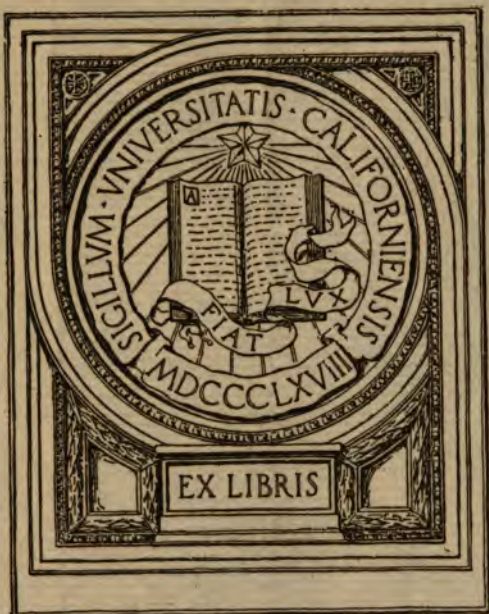
A5

UC-NRLF

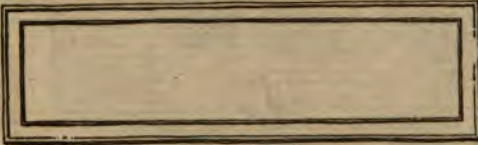


\$B 78 818

YC 69043



EX LIBRIS



# American Society of Municipal Improvements, 1914

## Specifications for Sewer Construction

Adopted October 8, 1914

These specifications will be modified from time to time to keep them fully up to date. Suggestions as to modifications or additions are solicited and should be sent to the Secretary, or to E. J. Fort, Municipal Building, Brooklyn, N. Y., Chairman of the Sub-Committee on Specifications for Sewers, and

**GEORGE W. TILLSON**

Boro Hall, Brooklyn, N. Y.

Chairman of General Committee on Standard Specifications

**COPYRIGHTED, 1914**

(Any municipality will be given free permission to use these specifications or any part of them upon application to the Secretary.)

**PUBLISHED BY THE SOCIETY**

**CHARLES CARROLL BROWN, Secretary**

702 WULSIN BUILDING

INDIANAPOLIS, INDIANA

TD 678  
#5

Press of  
S. E. Tate Printing Company  
Manhattan Building  
Milwaukee

1918  
JAN 10

## Modifications of these Specifications made in 1915

### REPORT OF SUB-COMMITTEE ON SPECIFICATIONS FOR SEWERS.

The sub-committee on Specifications for Sewers has further considered Articles 206 and 211 of its report, and the proposed amendments thereto, all of which were omitted from the Specifications for Sewer Construction, as adopted by the society at its last convention.

Article 206.—The amendment proposed by Mr. Parmley would materially reduce the specified thickness of reinforced concrete sewer pipes of large sizes. After careful consideration we are unable to recommend at this time the adoption of the dimensions proposed in the amendment. We also find the subject matter of the proposed amendment, covering the depth and details of socket and joint ends and of reinforcement material, is sufficiently covered by items of the specifications heretofore adopted.

We do, however, recommend that column 4 of Article 206, as proposed by the sub-committee, be omitted.

Article 211.—The amendment offered by Mr. Parmley proposes three different methods of applying crushing tests to reinforced cement concrete pipes, and specifies a different crushing load for each method. The sub-committee has considered these, and reached the opinion that proposed methods 1 and 2 are too complex, and hardly practicable, and that method 3, which substantially complies with the method proposed by the committee, specifies crushing loads which, in our opinion, are too low and unsafe.

The sub-committee has further considered Article 211 and has reached the additional conclusion, that the test pressures which the pipes shall withstand should be specified with more definiteness than at present. With this end in view it recommends the insertion of the words: "without collapse" before the words, "the following pressures," at the ends of both the first and second paragraphs of Article 211.

Otherwise, the committee recommends the adoption of Articles 206 and 211 as originally presented by it, with the omission of column 4 of tabular socket dimensions in Article 206.

Respectfully yours,

E. J. Fort, Chairman.  
Rudolph Hering,  
A. J. Provost.



## SPECIFICATIONS FOR SEWER CONSTRUCTION.

### TRENCHES.

#### LENGTH OF TRENCH.

1. Unless otherwise directed or permitted not more than ... feet of any trench in advance of the end of the built sewer shall be open at any time; and unless written permission to the contrary is given, the trench shall be excavated to its full depth for a distance of at least ... feet more than the minimum length of sewer permitted to be laid in it (see sections 152 and 158). Trenches for house connection drains shall not be open on both sides of the street at the same time, unless permission has previously been given to close the street. Unless otherwise directed, each trench for basin connections and house connection drains shall be fully excavated for its entire length before any pipes are laid therein.

#### SHEETING AND BRACING.

2. Where necessary, the sides of the trenches and excavations shall be supported by adequate sheeting and bracing. Steel sheeting may be used only where shown on the plan or directed. Sheeting and bracing will be paid for only when left in place by written order, in which event the amount left in place will be paid for at the contract price for such material. Unless specially permitted, sheeting against which concrete is placed shall not be removed, but such sheeting will not be paid for unless ordered to be left in place to protect the sides of the trenches and excavations. The Contractor will be held accountable and responsible for the sufficiency of all sheeting and bracing used, and for all damage to persons or property resulting from the improper quality, strength, placing, maintaining or removing of the same.



### SHEETING IN SOFT MATERIAL.

3. Where the material to be excavated is of such a character or other conditions are such as to render it necessary, the sheeting shall be closely driven and to such depth below the bottom of the sewer as may be directed.

### TUNNELING.

4. All work shall be done in open trenches or excavations, no tunneling shall be done except with the consent of the Engineer.

### TREES AND STUMPS.

5. The Contractor shall grub and clear the surface over the trenches, and the excavations of all trees, stumps, stones and any other incumbrances affecting the prosecution of the work, and shall remove them from the site.

### MATERIAL TO BE DISINFECTED.

6. If required by the Engineer, any or all of the excavated material shall be satisfactorily disinfected or deodorized or immediately removed from the work.

### ROADWAY, SIDEWALKS, ETC., TO BE KEPT CLEAR.

7. Unless permission is given to the contrary, the excavated material and materials of construction shall be so deposited, and the work shall be so conducted as to leave open and free for pedestrian traffic all crosswalks, a space on each sidewalk not less than one-third the width of the sidewalk and not less than 3 feet in width, and for vehicular traffic a roadway not less than 8 feet in width. All street hydrants, water gates, fire alarm boxes and letter boxes shall be kept accessible for use. Not more than ... linear feet of sidewalk shall be used at any time for storage of materials from any one trench. During the progress of the work the Contractor shall maintain such crosswalks, sidewalks and roadways in satisfactory condition, and the work shall at all times be so conducted as to cause a minimum of inconvenience to public travel, and to

permit safe and convenient access to private and public property along the line of the work.

#### SURPLUS MATERIAL.

8. If all of the excavated material cannot be stored on the street in such a manner as to maintain the traffic conditions hereinbefore specified, the surplus shall be removed from the work and stored. After the construction of the sewer, so much of this material as is of satisfactory quality and necessary for the purpose shall be brought back and used for backfilling the trench.

Material from first ... feet to be carted away.

9. Where directed, in built-up districts and in streets where traffic conditions render it necessary, the material excavated from the first ... feet of trenches shall be removed by the Contractor as soon as excavated, and the material subsequently excavated, if suitable for the purpose, shall be used to backfill the trenches in which the sewers have been built and neither the excavated material nor materials of construction shall be stored on the roadways or sidewalks.

#### FENCE.

10. Where required by the Engineer, suitable fences shall be placed along the sides of the trenches to keep the streets safe for traffic.

#### TEMPORARY BRIDGES.

11. Crosswalks, where intersected by trenches, shall if required be temporarily replaced by substantial timber bridges not less than 3 feet wide, with side railings. Where required, suitable temporary bridges for vehicles shall be provided and maintained across trenches.

#### DISPOSAL OF WATER FROM TRENCHES.

12. The Contractor shall at all times during the progress of the work keep the trenches and excavations free from water. Water from the trenches and excavations shall be disposed of in such a manner as will neither cause injury to

the public health, nor to public or private property, nor to the work completed or in progress, nor to the surface of the streets, nor cause any interference with the use of the same by the public.

#### COST TO BE COVERED.

13. The cost of all labor required to be done and all materials required to be furnished in the performance of all of the work specified in paragraphs 1 to 12, inclusive, except as otherwise provided, shall be covered by all the contract prices for all the items for which there are contract prices.

---

#### EARTH EXCAVATION.

14. Earth excavation shall include the removal of all material other than rock as defined in sections 21 and 22.

#### WIDTH OF TRENCH FOR SEWERS, ETC.

15. The minimum widths of trenches in earth for pipe sewers, basin connections, house connection and other drains not over 18 inches in diameter, shall be such as to give a clearance of 8 inches on each side of the barrel of the pipe, and for those of larger diameters, of 10 inches on each side of the barrel of the pipe, and all such trenches shall have a clear width equal to the maximum widths of the cradles of the sewers to be laid in them, when such cradles are wider than the minimum widths hereinbefore specified. The minimum clear widths of trenches in earth for other sewers shall be the greatest external width of the structures, including the necessary forms, to be built therein.

#### EXCAVATION FOR MANHOLES, ETC.

16. Where a riser, manhole or other appurtenance or the foundation therefor extends beyond the exterior lines of the sewer or its foundation, the minimum excavation in earth required for the same shall be that contained in a prism with vertical sides and a horizontal section equal to the smallest

rectangle which will enclose such appurtenance and its foundation.

#### EXCAVATION FOR RECEIVING BASINS, ETC.

17. The minimum dimensions of the excavation in earth for brick receiving basins, catchbasins and flush tanks shall be such as to give a clearance inside the sheeting of 1 foot on all sides above the foundation, but in all such cases the excavation shall be large enough to include the foundation for the structures shown on the plan. The excavation for concrete catch basins and flush tanks shall be of such dimensions as to permit the proper placing and removal of the necessary forms.

#### DEPTH OF TRENCHES.

18. Trenches shall be excavated to the depths required for the foundations of the sewers and appurtenances shown on the plan, and where conditions are such as to make it necessary, to such additional depths as may be directed. Where pipe is laid without a cradle, the bottoms of trenches shall be excavated to fit the lower third of the pipe, and excavations shall be made to receive the hubs. All irregularities in the bottoms of trenches shall be filled up to the required grade with suitable material.

#### COST TO BE COVERED.

19. The cost of all labor required to be done and all materials required to be furnished in the performance of all the work specified in paragraphs 14 to 18, inclusive, except as otherwise provided, shall be covered by all the contract prices for all the items for which there are contract prices.

#### ADDITIONAL EARTH EXCAVATIONS.

20. When there is a contract price for additional earth excavation, it shall cover the cost of excavating all material (other than rock) ordered to be excavated beyond the lines and depths herein specified in sections 15 to 18, inclusive, and also the cost of excavating all material within the lines

of the trenches above the surface of the ground as shown on the plan, when such material has not been placed there by the Contractor. This contract price shall also cover the cost of filling such excavations with approved material. Where no price is named in the contract for additional earth excavation, the cost of the several items enumerated above shall be covered by all the contract prices for all the items for which there are contract prices.

#### ROCK EXCAVATION.

##### DEFINITION.

21. Rock excavation shall include the excavation and removal of the following materials:

a. Rock which shall be determined to be of such a character as to warrant its removal by blasting, in order to insure the prompt and proper prosecution of the work.

b. Boulders and pieces of rock, masonry in mortar, and concrete, each of which contains one-third cubic yard or more, except the masonry and concrete of old sewers and their appurtenances.

22. Pieces of rock, masonry, concrete or boulders which fall or slide into the trench from beyond the lines thereof as herein defined, will not be measured, and the cost of the removal of the same shall be covered by all the contract prices for all the items for which there are contract prices.

##### WIDTH OF TRENCH.

23. The required width of trench in rock for pipe sewers, basin connections, house connections and other pipes will be such as to give a clearance of one foot on each side of the pipe, exclusive of spurs and hubs, the required width of trench in rock for other sewers and drains will be such as to give a clearance of one foot on each side of the structure to be built therein at its greatest external width. Where a riser, manhole or other appurtenance, or the foundation therefor, ex-

tends beyond the exterior lines of the sewer or its foundation, the excavation in rock required for the same will be that contained in a prism with vertical sides and a horizontal section one foot wider on each side than the smallest rectangle which will enclose such appurtenance and its foundation. The required dimensions of the excavation in rock for receiving basins, catch basins and flush tanks will be such as to give a clearance of one foot on all sides above their foundations.

#### DEPTH OF TRENCH.

24. The rock shall be excavated to the depths required for the cradles and foundations of the structures as shown on the plan, and not less than 4" below the outside of the barrel for the pipe sewers.

#### MEASUREMENT.

25. The volume of rock to be paid for will be that contained in prisms with vertical sides and of such dimensions as to give the widths and clearances hereinbefore specified from the bottoms of the trenches, as specified and as shown on the plan to the surface of the rock.

#### ROCK STRIPPED.

26. Rock shall be stripped in sections, which unless otherwise permitted, shall be not less than 50 feet in length, and the Engineer shall then be notified in order that he may measure the same. Rock excavated or blasted before such measurement is made will not be paid for.

#### EXCAVATION FOR BRANCHES.

27. Wherever a branch for a proposed sewer or extension of a sewer is built in rock, the required trench shall be excavated for a distance of not less than 5 feet beyond the end of such branch, in the direction of the proposed sewer or extension.

#### BLASTING.

28. All blasting operations shall be conducted in strict accordance with existing ordinances and regulations relative to

rock blasting and the storage and use of explosives. Any rock excavation within 5 feet of a water main less than 36 inches in diameter, and within 10 feet of a water main 36 inches or more in diameter, shall be done with very light charges of explosives, or, if directed, without blasting, and the utmost care shall be used to avoid breaking or disturbing the main.

#### EXPOSED STRUCTURE TO BE PROTECTED.

29. All exposed sewers, manholes, receiving basins and other structures shall be carefully protected from the effects of blasts. Any damage done to such structures shall be promptly repaired by the Contractor at his own expense.

#### PRICE TO COVER.

30. The contract price for rock excavation shall cover the cost of all labor and materials required to excavate and remove all rock as specified, and without regard to its subsequent use. When there is no contract price for rock excavation the cost of excavating and removing rock shall be covered by all the contract prices for all the items for which there are contract prices.

---

#### BACKFILLING.

##### BACKFILLING AROUND SEWERS, ETC.

31. Unless otherwise specified or directed, all trenches and excavations shall be backfilled immediately after the structures are built therein. For a depth of at least 2 feet over the top of sewers, basin connections, house connections and other drains, the material used for backfilling trenches as excavated shall be clean earth, sand or rock dust. It shall be carefully deposited in uniform layers not exceeding 6 inches in depth, and unless otherwise permitted each layer shall be carefully and solidly tamped with appropriate tools in such a manner as to avoid injuring or disturbing the completed work.

#### BACKFILLING FOR REMAINDER OF TRENCH.

32. Backfilling for the remainder of the trenches as excavated shall be approved material free from organic matter and containing no stones over 10 inches in their largest dimensions. Stones which are used in backfilling shall be so distributed through the mass that all interstices are filled with fine material. Backfilling shall be deposited as directed, and unless otherwise permitted shall be spread in layers and solidly tamped.

#### BACKFILLING AROUND MANHOLES, RECEIVING BASINS, ETC.

33. Backfilling within 2 feet of manholes, house connection drains, receiving basins, inlet basins, flush tanks and other structures shall be of the same quality as that specified in sections 31 and 32. It shall be uniformly deposited on all sides and unless otherwise permitted solidly tamped in such a manner as to avoid injuring the structures or producing unequal pressures thereon.

#### PUDDLING.

34. Backfilling shall, if required, be flooded or puddled with water as the work progresses, instead of being tamped.

#### CAVITIES FILLED.

35. When sheeting is drawn, all cavities remaining in or adjoining the trench shall be solidly filled. When sheeting is left in place, all cavities behind such sheeting shall be solidly filled as directed.

#### DEFICIENCY OF FILLING.

36. Unless otherwise shown on the plan, trenches shall be backfilled to the height of the surface of the ground as it existed at the commencement of the work. Should there be a deficiency of proper material for the purpose, the Contractor shall furnish and place such additional material as may be required.



#### TEMPORARY BULKHEADS.

37. For retaining backfilling only temporary bulkheads will be allowed. Such bulkheads shall not be of stone, and they shall be removed as the trenches are backfilled.

#### CURVES, BRANCHES, ETC., NOT TO BE COVERED.

38. Sewers built on curves, also drains, basin connections, house and sewer connections and intersections, ends of sewers and branches shall not be covered until the Engineer shall have inspected, measured and located the same, and given permission to backfill the trenches over them.

#### REMOVAL OF SURPLUS MATERIAL.

39. As trenches are backfilled, the Contractor shall remove all surplus material and regrade and leave free, clear and in good order all roadways and sidewalks to within ... feet of the end of the completed work. During the progress of, and until the final payment for and acceptance of, the work, he shall maintain in good and safe condition the surface of the street over all trenches, and promptly fill all depressions over and adjacent to trenches caused by settlement of backfilling. In case of failure or neglect on the part of the Contractor to comply with the requirements of this paragraph within 24 hours after the service upon him of a written notice so to do, the ... may furnish all materials and do all work required, and the cost thereof will be charged to the Contractor and deducted from any moneys due or to become due him under this contract. All surplus material or any part thereof shall, if required, be deposited as directed on the streets and avenues within the limits of this contract where surfaces are below grade, and in such a manner as to leave the surfaces of the filled material even.

#### COST INCLUDED.

40. The cost of all labor required to be done and all materials required to be furnished in the performance of all

the work specified in sections 31 to 39, inclusive, shall be covered by all the prices for the items for which prices are named in the contract.

CEMENT.

QUALITY.

41. All cement used in the work shall be high-grade Portland cement of well-established and approved brands.

SPECIFIC GRAVITY; WEIGHT.

42. The cement shall have a specific gravity of not less than 3.10 after being thoroughly dried at 212° F: It shall weigh not less than 376 pounds net, to the barrel, 4 bags of 94 pounds each being considered equivalent to a barrel. For the purpose of measurement one bag shall be considered as the equivalent of one cubic foot.

FINENESS.

43. The cement shall be dry, finely ground, of uniform color and free from lumps. It shall leave a residue of not more than 8 per cent. by weight when passed through a No. 100 sieve, and not more than 25 per cent. when passed through a No. 200 sieve.

TENSILE STRENGTH.

44. Standard briquettes shall develop, within the periods specified, tensile strength not less than that shown in the following table:

NEAT CEMENT.	Lbs. per sq. in.
24 hours in moist air.....	175
7 days (1 day in moist air, 6 days in water).....	500
28 days (1 day in moist air, 27 days in water).....	600
Mortar consisting of 1 part cement and 3 parts of standard Ottawa sand, by weight.	
7 days (1 day in moist air, 6 days in water).....	180
28 days (1 day in moist air, 27 days in water).....	225

The average of the tensile strength developed at each age by the briquettes in any set from one sample will be considered the strength of the sample at that age, excluding any results that are manifestly faulty. The average strength of briquettes at 28 days shall be greater than the average strength at 7 days, and if tests are made after 28 days the strength shall be not less than that at 28 days.

#### SOUNDNESS.

45. Pats of neat cement, when tested for constancy of volume or soundness, shall remain firm and hard and show no sign of checking, cracking, distortion or disintegration.

#### SETTING.

46. Unless otherwise required, cement shall not develop initial set in less than 30 minutes, and shall develop final set in not less than 1 hour nor more than 10 hours. Quick-setting cement of an approved brand shall, if required, be kept on the work in sufficient quantity to provide for any contingency requiring the use of the same.

#### TESTING.

47. Cement will be subjected to such tests as the Engineer may deem necessary, and such tests will be made in accordance with the methods recommended by the Committee on Uniform Tests of Cement of the American Society of Civil Engineers.

#### RE-TESTING.

48. Any cement which shall have been kept in storage after testing for a sufficient time to warrant it, shall be re-tested. Any prior acceptance shall be considered void and the acceptance or rejection of the cement shall depend upon the results of the latest tests.

#### APPROVAL OF BRAND MAY BE RESCINDED.

49. The engineer may at any time rescind the approval of any brand of cement that develops qualities which in his opinion unfit it for use in the work.

#### SAMPLES.

50. The contractor shall notify the engineer of the arrival of cement on the work, and furnish such facilities as may be required for obtaining samples for testing. Samples will be taken so as to fairly represent the material. The number of packages sampled and the quantity to be taken from each will depend upon the importance of the work and the number of tests to be made.

#### DELIVERY AND STORING.

51. Cement shall be delivered on the work in barrels or approved bags of uniform size with the brand and the name of the manufacturer plainly marked thereon, and shall be immediately stored in a dry place and carefully protected from the weather. A sufficient stock of cement shall be kept on the work in advance of the necessity for its use to permit of the making of the required seven-day tests. Except by written permission, no cement shall be used before it has been tested and accepted, and any concrete or masonry which may have been made under such permission with cement that is subsequently rejected, shall be removed and replaced with concrete or masonry made of accepted cement. All cement found to be of improper or inferior quality shall be immediately removed from the site of the work.

#### COST TO BE COVERED.

52. The cost of furnishing, storing and incorporating cement in the work, and the cost of samples required for testing, shall be covered by the contract prices for the structures or classes of work in connection with which the cement is used.

---

#### MORTAR.

#### COMPOSITION.

53. All mortar used in the work, unless otherwise specified, shall be composed of 1 volume of cement, as in the original package, and 2 volumes of sand. Mortar used in the haunch

walls of brick sewers shall be composed of 1 volume cement and 3 volumes of sand.

#### SAND.

54. The sand shall be clean and sharp, free from dirt, loam, mica and organic matter, and shall contain not more than 8 per cent. by volume of clay, and no clay shall be artificially added.

#### MIXING.

55. Mortar shall be mixed in a suitable box or on a tight platform, and never upon the ground. The cement and sand shall be thoroughly mixed dry, until the mixture has a uniform color. Clean, fresh water shall then be added and the mass worked until a mortar which is uniform and of the required consistency is produced. Mortar shall be mixed in no greater quantity than is required for the work in hand, and any that has set sufficiently to require retempering shall not be used.

#### FREEZING WEATHER.

56. The mixing and use of mortar in freezing weather shall be subject to the same requirements as hereinafter specified for mixing and placing concrete under similar conditions.

#### COST COVERED.

57. The cost of all labor and materials required to furnish and place mortar in the work, as specified, shall be covered by the contract price for the structure or class of work in connection with which the mortar is used.

---

#### CONCRETE.

##### CLASS A CONCRETE.

58. Class A concrete shall be made of 1 part of cement, 2 parts of sand and 4 parts of broken stone or gravel.

Broken stone for Class A concrete shall be hard, sound and durable and shall not contain loam, clay, organic matter, objectionable quantities of dust or other improper material.

Broken stone for Class A concrete shall be the run of the crusher that will pass through a screen with circular openings 1 inch, 1½ inch and 2 inches in diameter and be retained on a screen with openings ⅛ inch in diameter. Gravel shall be of hard, sound, durable material equal in quality to that specified for broken stone. It shall be clean and of the sizes herein specified for broken stone.

#### CLASS B CONCRETE.

59. Class B concrete shall be made of 1 part of cement, 2½ parts of sand and 5 parts of broken stone or gravel.

Broken stone, gravel and sand for Class B concrete shall in all respects comply with the requirements specified for the same materials for Class A concrete.

#### CLASS C CONCRETE.

60. Class C concrete shall be made of 1 part of cement, 3 parts of sand and 6 parts of broken stone or gravel. Broken stone for Class C concrete shall be the run of the crusher that will pass through a screen with circular openings 1 inch, 1½ inch and 2 inches in diameter and be retained on a screen with circular openings ⅛ inch in diameter. Gravel for Class C concrete shall be as specified for Class A concrete.

Broken stone, gravel and sand for Class C concrete shall in all respects comply with the requirements for similar materials for Class A concrete, except as to sizes as above specified.

#### RUBBLE CONCRETE.

61. Rubble concrete shall consist of Class B concrete with large stones embedded therein.

The embedded stones shall be hard, sound and durable, roughly cubical in shape and of such sizes as may be deemed suitable for the mass in which they are to be used. They shall be laid on their largest beds and be so placed in the work that they will not be nearer than 9 inches to the bottom of a footing, to an expansion joint, to any surface or to each other. The stones after having been thoroughly cleaned and wetted

shall be firmly bedded in the concrete. The joints shall then be filled and the stones covered with concrete to such a depth that the spacing specified will be obtained. The stones shall not be placed directly on any concrete which has acquired its initial set.

#### MEASURING INGREDIENTS.

62. For the purpose of determining the proportions of the materials for concrete, each bag of cement will be considered as containing 1 cubic foot and the other ingredients shall be measured by an approved method.

#### WATER.

63. Only clean, fresh water shall be used for concrete.

#### MIXING.

64. Unless permitted to be mixed by hand, concrete shall be mixed in approved mechanical batch mixers, so constructed and operated that the ingredients of the concrete may be accurately measured and will be thoroughly mixed. Enough water shall be added during the mixing to bring the concrete to the required consistency, which for concrete laid in place shall generally be such that the concrete may be poured into place without causing the separation of the stones from the mortar. When concrete is mixed by hand the broken stone or gravel shall be thoroughly wet before it is used. The cement and sand shall be mixed in the proper proportions dry until the mixture has a uniform color. It shall then be made into mortar of the desired consistency. The broken stone shall be added and the entire mass turned until each stone is entirely coated with mortar.

#### PLACING CONCRETE.

65. Concrete shall be mixed only in such quantity as is required for the work in hand, and any that has set sufficiently to require re-tempering shall not be used. Any concrete in which the water has separated from the solid matter shall be satisfactorily remixed before being placed. The con-

crete shall be so deposited in the work as to prevent the separation of the stone from the mortar. It shall be deposited in as nearly a continuous operation as practicable and shall be worked, tamped, spaded or rammed with suitable tools to produce a dense and compact mass. When the operation of placing concrete is interrupted the concrete in the work shall, if required, be confined by suitable temporary forms or bulkheads. When concrete is to surround re-inforcing rods, structural steel or wire netting, it shall be so deposited as to work closely around such material. When a comparatively dry concrete is used it shall be deposited in horizontal layers not exceeding 6 inches in depth and solidly tamped.

#### JOINING OLD AND NEW CONCRETE.

66. When fresh concrete is to be laid on or adjoining concrete already set, the surface of the latter shall be thoroughly cleaned, washed and roughened, and coated with a grout of neat cement before the fresh concrete is deposited.

#### FORMS AND CENTERS.

67. The Contractor shall provide all necessary forms and centers for shaping concrete. They shall be true to the required shapes and sizes, strong enough and so secured in place as to withstand all operations incidental to placing the concrete, and watertight, and the faces against which the concrete is to be placed shall be satisfactorily smooth and clean. When lumber is used in forms and centers for exposed faces it shall be of seasoned stock and shall be coated as directed with an approved lubricant.

#### REMOVAL OF FORMS AND CENTERS.

68. Forms and centers shall be left in place until the concrete has set sufficiently to permit their removal without danger to the structure, and until so much of the backfilling or embankment as may be directed has been put in place. No forms or centers shall be struck or removed until permission to do so has been given by the Engineer.



#### EXPOSED SURFACES.

69. Special care shall be used to secure smooth and uniform finish to the surfaces of concrete which will be exposed in the completed structure. Immediately after the removal of the forms such surfaces if uneven shall be rubbed smooth to a uniform and satisfactory finish. All exposed edges of concrete shall be neatly rounded as directed, and if any voids, projections or other imperfections be found, such defects shall at once be corrected by tooling, cutting out and filling with mortar, or otherwise, as directed. .

#### EXPANSION JOINTS.

70. Expansion joints shall be provided in such manner and at such places as are shown on the plan or as may be directed. All unavoidable joints shall be made as shown on the plan or as directed.

#### DEPOSITING CONCRETE UNDER WATER.

71. Whenever it becomes necessary to place concrete under water, it shall be deposited by means of drop-bottom buckets, closed chutes or other approved method. Concrete so deposited shall be carefully spread without tamping.

#### FREEZING WEATHER.

72. In freezing weather, until the temperature falls to 24° F. the water used for concrete shall, if directed, be heated to an approved temperature, and if directed, 1 per cent. by weight of salt shall be added to the water for each degree Fahrenheit that the temperature of the air is below 32° F. Other materials for concrete shall be heated sufficiently to remove all frost and ice. No concrete shall be laid when the temperature of the air is below 24° F.

#### PROTECTION.

73. Concrete shall be allowed to set for such time as may be directed before it is worked or walked upon, or before backfilling or other material is placed upon or against it. It

shall not be flooded with water until it has sufficiently set. Concrete shall be carefully protected from injury by freezing and from the drying effects of the sun and wind by covering it with canvas, bagging, hay or other suitable and approved materials. Such protection shall be placed as soon as the concrete is in condition to receive it, and except in freezing weather, the covering as well as the concrete shall be kept wet for such time as may be directed.

#### MEASUREMENT.

74. The amount of concrete to be paid for as such will be all concrete put in place as shown on the plan or as directed, except such concrete shown on the plan as parts of structures for which there are contract prices and the cost of which is hereinafter specified as covered by the contract prices for such structures.

#### PRICES TO COVER.

75. The contract prices for the various classes of concrete shall cover the cost of all labor and materials required to furnish, place and remove all necessary forms and centers, and to make, place, furnish and protect the concrete as specified.

---

#### BRICK MASONRY.

##### QUALITY OF BRICKS.

76. All bricks used in the work shall be sound and hard burned throughout and of uniform size and quality. If required, the bricks shall be culled immediately after they are brought on the work and all bricks which are warped, cracked or of improper size, shape or quality shall be at once removed. The proportion of bats permitted will be determined according to the character and location of the work in which they are to be used. When bricks are used for lining inverts and in neat arch courses of sewers they shall be specially selected and no bats shall be used except for closers.

## VITRIFIED BRICKS.

77. Where shown on the plan, vitrified bricks of approved size and quality shall be furnished and laid. After having been thoroughly dried and then immersed in water for 24 hours they shall not absorb more than 4 per cent. of their weight of water.

### HOW LAID.

78. Bricks shall be satisfactorily wet when being laid and each brick shall be laid in mortar so as to form full bed, end and side joints in one operation. The joints shall be not wider than  $\frac{3}{8}$  inch, except when the bricks are laid radially, in which case the narrowest part of the joint shall not exceed  $\frac{1}{4}$  inch. The bricks shall be laid in a workmanlike manner, true to line, and wherever practicable the joints shall be carefully struck and pointed on the inside. Brickwork shall be laid with a satisfactory bond, and as it progresses shall be racked back in courses, unless otherwise permitted.

---

## BRICKWORK.

### PROTECTION.

79. All fresh brickwork shall be carefully protected from freezing and from the drying effects of the sun and wind, and if required, it shall be sprinkled with water at such intervals and for such a time as may be directed. Brickwork shall be protected from injuries of all sorts, and all portions which may become damaged or may be found defective shall be repaired, or if directed, removed and rebuilt.

### FREEZING WEATHER.

80. In freezing weather bricks shall be heated when directed, sufficiently to remove all ice and frost.

### MEASUREMENT.

81. The amount of brick masonry to be paid for as such will be all brick masonry built, as shown on the plan or as

directed, except such brick masonry shown on the plan as parts of structures for which there are contract prices and the cost of which is hereinafter specified to be covered by the contract prices for such structures.

#### PRICE TO COVER.

82. The contract price for brick masonry shall cover the cost of all labor and materials required to build and protect the same as specified.

---

#### CUT STONES.

##### MATERIALS.

83. Where shown on the plan, cut stones of the required kind, form, dimensions and finish, shall be furnished and accurately set in full beds of mortar. The stones shall be sound, durable and free from rifts, seams and laminations, and other imperfections.

##### COST COVERED.

84. The cost of all labor and materials required to furnish and set cut stones as specified shall be covered by the contract price for the structure or class of work in connection with which they are used.

---

#### CEMENTED RUBBLE MASONRY.

##### MATERIALS.

85. Stones for rubble masonry shall be hard, sound, free from checks and shakes, as nearly rectangular as practicable, and unless used for trimming or closers, not less than 6 inches thick. The stones shall be cleaned and wetted immediately before being placed in the work; they shall be laid on their natural beds, in full beds and joints of mortar, with spalls firmly embedded therein. In walls, one-third of the stones shall be headers extending through the walls where the same do not exceed 3 feet in thickness.

#### How LAID.

85a. All rubble masonry laid in mortar shall be laid to line, thoroughly and satisfactorily bonded, and in courses roughly levelled up. When the laying of rubble masonry in mortar is interrupted the tops of the courses shall be left unplastered. No dressing or tooling shall be done on or upon any stone after it is in place. Immediately before any rubble masonry in mortar is laid on or against any such masonry in which the mortar has set, the surface of such masonry shall be thoroughly cleaned and wetted. Rubble masonry laid in mortar shall not be laid in freezing weather.

#### POINTING.

86. When the faces of rubble masonry laid in mortar will be exposed to view in the finished work, the joints in such faces shall be raked out to a depth of not less than 1 inch and neatly pointed with mortar composed of 1 part cement and 2 parts sand.

#### MEASUREMENT.

87. The amount of rubble masonry laid in mortar to be paid for as such will be all cemented rubble masonry built as shown on the plan or as directed, except such shown on the plan as being part of structures for which there are contract prices, and the cost of which is hereinafter specified to be covered by the contract prices for such structures.

#### PRICE TO COVER.

88. The contract price for cemented rubble masonry shall cover the cost of all labor and materials required to construct the same, as specified.

---

#### DRY RUBBLE MASONRY.

##### How LAID.

89. Dry rubble masonry shall conform to the requirements specified in sections 85 and 87, except those that relate to the use of mortar. All joints shall be thoroughly pinned and wedged with suitable spalls.

PRICE TO COVER.

90. The contract price for dry rubble masonry shall cover the cost of all labor and materials required to construct the same, as specified.

---

STONE BALLAST.

QUALITY.

91. Stone ballast shall be broken stone, clean, sound, hard and roughly cubical in shape and unless otherwise shown on the plan or directed, of sizes ranging from 1 inch to 4 inches. Cobbles, if satisfactory, may be used.

PRICE TO COVER.

92. The contract price for stone ballast shall cover the cost of all labor and materials required to furnish and place the same as specified.

---

STRUCTURAL STEEL.

QUALITY.

93. All structural steel used shall be medium steel for members and rivet steel for rivets made by the open hearth process and shall conform to the latest revised Standard Specifications for Structural Steel for Buildings adopted by the American Society for Testing Materials, and such tests as may be required shall be made in accordance therewith and at the places hereinafter specified. The chemical and physical properties of the steel shall be as follows:

Properties considered.	Medium Steel.	Rivet Steel.
Phosphorus (maximum) ..	0.06 per cent.	0.06 per cent.
Ultimate tensile strength, pounds per square inch .....	55,000-65,000	48,000-58,000
Yield point .....	½ ult. tens. str.	½ ult. tens. str.
Elongation, per cent. in 8 inches (minimum) .....	1,400,000	1,400,000
	ult. tens. str.	ult. tens. str.
Character of fracture.....	Silky	Silky
Cold bend without fracture.....	180° to diameter of one thickness.	180° flat.

#### FINISH.

94. All finished material shall be free from injurious seams, flaws and cracks, and have a workmanlike finish.

#### VARIATION IN WEIGHT.

95. When steel is inspected at the mill or shop all pieces (except plates), which vary in weight more than  $2\frac{1}{2}$  per cent. from that specified, shall be rejected, when steel is not inspected until it is delivered on the work such variation in weight will be sufficient cause for rejection when in the judgment of the Engineer the safety of the work will be impaired thereby.

#### WORKMANSHIP.

96. All structural steel shall be in accordance with the plan and approved shop drawings. All details not shown on the plan, and all workmanship and finish shall be equal to the best current practice in similar work for buildings.

#### ANCHOR BOLTS.

97. Anchor bolts and expansion bolts shall be furnished where required and set in place as directed. When holes are drilled in masonry or concrete for such bolts, the holes shall be washed clean and the bolts shall be firmly embedded in a mortar composed of equal parts of cement and sand, unless other material is shown on the plan.

#### MELT NUMBERS.

98. Test specimens and every finished piece of steel shall be stamped with melt or blow number, except that small pieces may be shipped in bundles securely wired together, with the melt or blow number on a metal tag attached.

#### TESTS AND INSPECTIONS.

99. The required tests and inspections of structural steel shall, if directed, be made at the mills and shops by the city's authorized inspector. The Contractor shall notify the Engineer as to the mills and shops which are to supply the

steel, sufficiently in advance to enable the Engineer to arrange for such tests and inspections and the mills and shops shall afford every facility for making the same.

#### MILL CERTIFICATES.

100. If it is decided not to make the tests and inspections at the mills, then mill certificates showing the properties of each melt of which the steel is made will be accepted for consideration.

#### SHIPPING INVOICES.

101. The Contractor will be required to furnish complete copies of shipping invoices with each shipment of steel.

#### CERTIFICATES, ETC., FOR INFORMATION ONLY.

102. Steel will not be accepted until the required inspector's reports or mill certificates are received. All tests, inspection, reports and certificates are for the information of the Engineer, and he shall not be precluded on account thereof from requiring or making any further tests which he may deem necessary.

#### SHOP DRAWINGS.

103. The Contractor shall prepare complete and accurate shop drawings of all steel work, and no shop work shall be done until such drawings shall have been approved. The Contractor shall furnish to the Engineer 3 complete sets of prints of the approved shop drawings.

#### PAINTING.

104. All steel shall be thoroughly cleaned of scale, rust, oil and dirt, and unless otherwise directed, those parts which are not to be bedded in concrete shall be painted with a priming coat of the best red lead and linseed oil or such other paint of equivalent value as may be directed. After erection, the metal which will be exposed in the finished work shall be evenly painted with 2 coats of approved paint. No painting shall be done on wet surfaces.



#### MEASUREMENT.

105. The amount of structural steel paid for as such will be all structural steel placed in the work in accordance with the plan or directions, except any excess greater than  $2\frac{1}{2}$  per cent. above the weight required, and except such structural steel shown on the plan as part or parts of structures for which there are contract prices, and the cost of which is hereinafter specified to be covered by the contract prices for such structures.

#### PRICE TO COVER.

106. The contract price for structural steel shall cover the cost of all labor and materials required to furnish, fabricate, erect and paint the same, to furnish all test pieces, to prepare and furnish prints of shop drawings, and to drill holes for and set anchor and expansion bolts, where required, all as specified.

---

#### STEEL REINFORCEMENT BARS.

##### SHAPE.

107. Steel bars for reinforcing concrete shall be of such shape as to afford an approved mechanical bond with the concrete and to insure intimate contact between the steel and concrete. Plain bars may be used only when shown on the plan.

##### SAMPLES.

108. The Contractor shall indicate the type of bars proposed to be used and if required shall furnish samples thereof, and he is cautioned not to place the order for bars until the type has been approved.

##### SIZE.

109. Each bar shall have a net cross sectional area equivalent to that designated on the plan or required, or it shall be the commercial size of the approved type of bar having a net cross sectional area next larger than that designated or required.

## VARIATION IN WEIGHT.

110. Reinforcement bars will be rejected if the actual weight varies more than 5 per cent. from their theoretical weight, as shown by the manufacturer's tables. For weighing reinforcement bars the Contractor shall, whenever required, provide an accurate scale of an approved type, with a capacity of not less than 500 pounds.

## QUALITY.

111. All steel for reinforcement bars shall be made by the open hearth process, and shall conform to the latest revised Standard Specifications for Steel Reinforcement Bars adopted by the American Society for Testing Materials.

The chemical and physical properties of the steel shall be as follows:

Properties Considered.	Structural Steel Grade.		Hard Grade.*	
	Plain bars.	Deformed bars.	Plain bars.	Deformed Cold twisted bars.
Phosphorus, maximum				
Bessemer .....	0.10	0.10	0.10	0.10
Open Hearth ....	0.05	0.05	0.05	0.05
Ultimate tensile strength pounds per sq. inch .....	55,000 to 70,000	55,000 to 70,000	80,000 min.	80,000 min. only.
Yield point, minimum, pounds per sq. inch .....	33,000	33,000	50,000	50,000
Elongation, minimum, per cent. in 8 inches.	1,400,000	1,250,000	1,200,000	1,000,000
	tens. str.	tens. str.	tens. str.	tens. str.
Cold bend without fracture:				
Bars under ¾-in. in diameter or thickness .....	180° d=1t.	180° d=1t.	180° d=3t.	180° d=4t.
Bars ¾-in. in diameter or thickness and over .....	180° d=1t.	180° d=2t.	90° d=3t.	90° d=4t.
			180° d=3t.	

\*The hard grade will be used only when specified.

t=Nominal thickness or diameter of bar.

112. Reinforcement bars shall be rolled from billets of new steel; they shall be straight and free from seams, flaws, cracks and imperfections of all kinds.

#### TESTS AND INSPECTIONS.

113. The provisions of sections 95, 98, 99, 100 and 102 relating to tests and inspections of structural steel shall also apply to tests and inspections of steel reinforcement bars.

114. Test pieces 18 inches long may be cut from any of the bars delivered on the work, and the failure of any test piece to meet the specified requirements, or the failure of any bar when being tested or handled shall be deemed sufficient cause for the rejection of all steel from the melt from which the test piece or bar was made.

#### PROTECTION.

115. Bars shall be protected at all times from mechanical injury and from the weather, and when placed in the work they shall be free from dirt, scale-rust, paint and oil. Bars which are to be embedded in concrete, but which remain exposed for some time after being placed in the work, shall, if directed, be immediately coated with a thin grout of equal parts of cement and sand.

#### CUTTING AND BENDING.

116. Bars shall be bent to the shapes shown on the plan and in conformity with approved templets. When bars are cut and bent on the work, the Contractor shall employ competent men and shall provide the necessary appliances for the purpose.

#### PLACING.

117. All bars shall be as long as can be conveniently used, accurately bent, placed, spaced and jointed as shown or directed, and they shall be securely held in their positions by approved devices until the concrete has been placed around them.

### JOINTS.

118. Where more than one bar is necessary to complete a required length the joints shall be made by means of approved clamps which will develop the full strength of the bars or by looping the ends of the bars around each other in such a manner as to produce and maintain tension on the joint during construction or by lapping the ends of the bars, as directed, and wiring them together in an approved manner, or by lapping the ends of the bars for a distance of 21 times their nominal diameters for deformed bars, and 40 times their nominal diameters for plain bars, and with a space not less than 2 inches between them. Joints in longitudinal bars shall be staggered as directed.

### MEASUREMENT.

119. The weight of steel reinforcement bars paid for as such will be the weight computed from the lengths and theoretical net sections of the steel reinforcement bars placed in the work in accordance with the plan or directions, except such steel reinforcement bars shown on the plan as part or parts of structures for which there are contract prices, and the cost of which is hereinafter specified to be covered by the contract prices for such structures. The weight paid for will not include the lengths of bars used for laps or wires, clamps and other devices used for spacing, jointing and securing the bars in place, or lugs, corrugations and irregularities which increase the weight of the bars above the weight of plain steel bars of the same net cross sectional areas, the cost of all of which shall be covered by the price bid for steel reinforcement bars. In computing the weight of bars, 1 cubic foot of steel will be considered to weigh 489.6 pounds.

### PRICE TO COVER.

120. The concrete price for steel reinforcement bars shall cover the cost of all labor and materials required to furnish, clean, cut, bend, place, join, secure and protect the same, to furnish all test pieces and samples, all as specified.

## WIRE NETTING.

### TYPE, QUALITY, ETC.

121. Wire netting of approved type and quality, and of the mesh and gauge of wire shown on the plan shall be furnished and placed where shown or directed. The netting shall be of steel wire. When placed in the work, wire netting shall be free from dirt, paint, oil and rust-scale. It shall be securely held in place by an approved method until the concrete has been placed around it.

### PRICE TO COVER.

122. The cost of all labor and materials required to furnish and place wire netting as specified shall be covered by the contract price for the structure or class of work in connection with which it is used.

---

## EXPANDED METAL.

### TYPE, QUALITY, ETC.

123. Expanded metal of approved type and quality and of the weight and size of mesh shown on the plan shall be furnished and placed where shown or directed. When placed in the work, it shall be free from dirt, scale, rust, paint and oil. It shall be placed in position with adjoining sheets lapped 1 mesh, and secured by an approved method until the concrete has been placed around it.

### MEASUREMENT.

124. The amount of expanded metal paid for as such will be all expanded metal placed in the work in accordance with the plan or directions, except such expanded metal shown on the plan as part or parts of structures for which there are contract prices for such structures, and which is hereinafter specified to be covered by contract prices for such structures. The amount paid for will not include waste material cut from sheets, nor the material used for laps, nor wires, clamps

and other devices used in joining and securing the expanded metal in place, the cost of all of which shall be covered by the contract price for expanded metal.

#### PRICE TO COVER.

125. The contract price for expanded metal shall cover the cost of all labor and materials required to furnish, clean, cut, bend, place, join and secure the same as specified.

---

#### WROUGHT IRON.

##### QUALITY.

126. Wrought iron shall be double-rolled, tough, fibrous and uniform in quality. It shall be thoroughly welded in rolling and be free from surface defects. It shall have an ultimate tensile strength of at least 48,000 pounds per square inch, a yield point of 25,000 pounds per square inch, an elongation of at least 20 per cent. in 8 inches, and a fracture wholly fibrous. Specimens shall bend cold, with the fiber, through 180 degrees around a diameter equal to the thickness of the piece tested. When nicked and bent the fracture shall be at least 90 per cent. fibrous.

##### GALVANIZING, PAINTING.

127. When required by the plan exposed wrought iron shall be thoroughly and uniformly galvanized. When not required to be galvanized exposed wrought iron shall be painted as specified in paragraph 104.

##### MEASUREMENT.

128. The amount of wrought iron paid for as such will be all wrought iron placed in the work in accordance with the plan or directions, except any excess greater than 2½ per cent. above the weight required, and except such wrought iron shown on the plan as part or parts of structures for which there are contract prices, and the cost of which is hereinafter specified to be covered by the contract prices for such structures.

PRICE TO COVER.

129. The contract price for wrought iron shall cover the cost of all labor and materials required to furnish, fabricate, erect and galvanize or paint the same, as specified, and to furnish all test pieces required.

---

IRON CASTINGS.

QUALITY.

130. Iron castings shall be of the best foundry pig iron, gray, tough and free from cold shuts, blow holes and other imperfections. (The weight shall be conspicuously painted by the manufacturer with white oil paint on each casting.) The castings shall be sound, true to form and thickness, clean and neatly finished. Where required castings shall be thoroughly coated with coal tar pitch varnish.

PRICE TO COVER.

131. The cost of all labor and materials required to furnish, place and coat the castings as specified, shall be covered by the contract price for the structure or class of work in connection with which they are used.

---

TIMBER.

QUALITY.

132. All timber shall be ... as specified, and shall be sound and free from shakes, cracks, large or loose knots, and other defects impairing its strength or durability. It shall be squared to the required dimensions throughout its entire length.

PLACING.

133. Timber shall be placed as shown on the plan or directed, and where necessary shall be firmly spiked or bolted with approved nails, spikes or bolts of such sizes and lengths and at such places and in such numbers as shown on the plan, or as directed.

#### MEASUREMENT.

134. The amount of timber to be paid for as such will be all timber placed in the work in accordance with the plan or directions, except piles and timber sheeting and except such timber shown on the plan as part or parts of structures for which there are contract prices, and the cost of which is hereinafter specified to be covered by the contract prices for such structures. The amount paid for will not include timber used for forms, templets, centers, scaffolds, bridges (unless otherwise specified), fences, guard rails or other temporary structures, the cost of all of which shall be covered by all the contract prices for all the items for which there are contract prices. No deduction will be made in the measurement of timber on account of the spaces occupied by the piles.

#### PRICE TO COVER.

135. The contract price for timber shall cover the cost of all labor and materials required to furnish, work, place and secure the same as specified.

---

#### TIMBER SHEETING.

##### QUALITY, PLACING, ETC.

136. Timber sheeting and the rangers and braces for the same shall be of a satisfactory quality of timber and of sufficient size and strength to adequately support the sides of the trenches and excavations. Sheeting shall be driven in such a manner as to avoid cracking and splitting, and if required, for the proper prosecution of the work, shall be tongued and grooved.

#### WHEN PAID FOR.

137. Timber sheeting will be paid for as such only when left in place by written order. When sheeting is left in, so much of it below the surface of the ground as may be directed shall be cut off.



### MEASUREMENT.

138. The amount of timber sheeting to be paid for as such will be all timber sheeting, rangers and braces left in by written order, and will not include sheeting, rangers and braces left in place without such order, nor sheeting left in place because concrete is placed against it, nor that part of the sheeting that extended above the uppermost ranger after having been driven, the cost of all of which shall be covered by all the contract prices for all the items for which there are contract prices.

### PRICE TO COVER.

139. The contract price for timber sheeting shall cover the cost of all labor and materials required to furnish, place and cut off the sheeting, rangers and braces as specified, and shall also cover the cost of all excavation necessary to place the same.

---

### PILES.

#### QUALITY.

140. Piles shall be of yellow pine or ..., as specified, sound and free from splits, shakes and other imperfections impairing their strength or durability. They shall be straight, taper uniformly from butt to point, and if so specified shall be barked. Unless otherwise shown on the plan, they shall conform to the following dimensions:

Length below cut-off.	Minimum diameter at point. inches.	Minimum diameter at cut-off. inches.
Less than 20 feet.....	6	10
20 feet to 25 feet.....	6	11
26 feet to 35 feet.....	6	12
36 feet to 45 feet.....	6	13
46 feet and over.....	6	14

To determine the necessary length of piles to be used in the work, the Contractor may be required to drive test piles.

141. Each pile less than 60 feet long shall be in one piece; piles longer than 60 feet may be spliced in an approved man-

ner. The small ends of piles shall be pointed, and, if required, shall be shod with approved *iron shoes*. The butt ends shall be cut off square and protected while driving with iron bands or caps.

#### HOW DRIVEN.

142. Piles shall be driven without the use of a follower, unless specially permitted. Pile heads that become split or broomed shall be cut off and the driving continued. Any pile which splits, breaks or drives unsatisfactorily will not be paid for, and it shall be withdrawn or abandoned and another driven in place of it. After being driven, all piles shall be accurately cut off at the required elevation.

#### BEARING PILES.

143. Bearing piles shall be driven vertically and shall be spaced as shown on the plan or as directed. They shall be driven to a satisfactory refusal by a hammer having a concave face and weighing not less than 2,000 pounds. Refusal in general will be indicated by a penetration not exceeding 1 inch per blow under the last 6 blows of a 2,000-pound hammer falling 15 feet. If steam hammer pile drivers are used, the piles shall be driven so that their bearing power shall be not less than that of piles driven as herein specified. When it is shown on the plan or specified that piles are to be driven to a certain required depth, they shall be driven by the use of a water jet, hammer, or by any other approved method as may be necessary to reach this depth.

#### BRACE PILES.

144. Where shown on the plan, brace, batter or spur piles shall be driven at the inclination shown or directed, and the tops shall be framed, bolted, or strapped to adjoining piles or to each other as shown on the plan.

#### MEASUREMENT.

145. The amount of piles to be paid for will be the total length below cut-off of all piles remaining in the work in ac-

cordance with the plan or directions, and the total length of all piles used only as test piles. Piles driven for temporary use will not be paid for.

#### PRICE TO COVER.

146. The contract price for piles shall cover the cost of all labor and materials required to furnish, drive and cut off the same as specified, of fastening brace piles, and of furnishing and placing all shoes, bands, bars, straps, bolts and other fastenings required.

---

#### CONCRETE SEWERS.

##### INVERTS.

147. Inverts of concrete sewers shall be formed between transverse templets and shall be screeded, unless other material is used for lining. The templets shall be placed at such intervals as to divide the invert into sections of suitable size for convenient construction, and unless otherwise permitted, the concrete shall be deposited in alternate sections and allowed to set before the remaining sections are built. Unless otherwise shown on the plan, a layer of mortar not less than  $\frac{1}{2}$  inch thick shall be spread evenly and to a smoothly finished surface upon the concrete of the invert as soon as such concrete is in place. Where the radii of inverts are too short to permit screeding between templets, the inverts shall be shaped by means of suitable forms, which shall be removed as soon as the concrete has a sufficient set, and if required, the surfaces of inverts shall be floated or troweled to a smooth finish. The concrete for inverts shall be deposited continuously for their entire cross sections, and for such longitudinal distances as may be convenient. Where shown on the plan, inverts shall be lined with brick masonry, tile or other material, which shall be laid at such times and in such manner as may be directed. Inverts shall be carefully protected from all injury during progress of the work.

#### SIDE WALLS.

148. Concrete in the side walls of sewers shall be deposited continuously to the height directed and for such longitudinal distances as may be convenient.

#### Roof.

149. Concrete in the roofs of sewers shall be deposited continuously for the full depths and widths of the roofs and for such longitudinal distances as may be convenient. The outer surfaces of roofs shall be finished with an excess of mortar and left true and smooth. They shall be covered and protected as specified in section 73, and such covering shall remain thereon until the backfilling or embankment is placed.

#### BULKHEADS.

150. While being deposited concrete for sewers shall be confined by temporary vertical bulkheads placed at such intervals longitudinally as may be required for convenient working. The bulkheads shall be so designed as to give an approved shape to the end of the section of concrete under construction, shall be satisfactorily secured in place before the concrete is deposited, and shall remain in place until the concrete has set sufficiently to hold its shape.

#### RE-INFORCEMENT.

151. Where shown on the plan concrete sewers shall be re-inforced with metal of the dimensions and shapes shown, and of the quality and in the manner hereinbefore specified.

#### MINIMUM LENGTH OF INVERT.

152. Unless otherwise permitted or ordered, not less than 16 feet of foundation or invert for concrete sewer shall be built at one operation.

#### CONNECTIONS.

153. Connections and branches for lateral sewers and receiving basins shall be built in where shown on the plan or

where directed. Such connections and branches shall be closed with bulkheads of brick masonry 8 inches thick unless otherwise shown on the plan. All necessary openings and bulkheads for branch sewers shall be built in concrete sewers where shown on the plan or where directed.

#### MEASUREMENT.

154. The lengths of concrete sewers will be determined by measurements along their invert parallel to their center lines. No deductions will be made on account of openings at branches and manholes. The measurement of a branch concrete sewer will be made from the inner surface of the wall of the main sewer to which it connects. A reducer will be paid for at the contract price for the sewer at the larger end thereof.

#### PRICES TO COVER.

155. The contract prices for concrete sewers shall cover the cost of all necessary excavation (except rock, when there is a contract price for rock excavation); of furnishing, maintaining and removing all forms, centers templets, and temporary bulkheads; of all openings and bulkheads; also the removal of all bulkheads in the ends of sewers to which connection is made by the sewers in this contract; of all back-filling; of all embankments required; and of all labor and materials required to construct concrete sewers as shown by the normal sections on the plan and as specified.

---

#### BRICK SEWERS.

##### INVERTS.

156. Inverts of brick sewers shall conform to lines drawn between transverse templets, and shall be lined with specially selected bricks, unless vitrified bricks are called for on the plan; no bats shall be used except for closers.

##### ARCHES.

157. The arches of brick sewers shall be built on substantial centers and shall be keyed with stretchers in full

joints of mortar. No bats shall be used in the neat courses except for closers. The centers shall be true to the required shapes and sizes and shall be strong enough and so secured in place as to withstand all operations incidental to the construction of the arches. The extrados of the arches shall be smoothly and evenly plastered with a layer of mortar  $\frac{1}{2}$  inch thick. The centers shall be left in place until the mortar has set sufficiently to permit their removal without danger to the arches, and until the trench is backfilled for its full width to a height of at least 1 foot above the crown of the extrados of the arches. No centers shall be struck or removed until permission to do so has been given.

#### MINIMUM LENGTH OF CRADLE.

158. Unless otherwise permitted or ordered, not less than 16 feet of foundation or cradle for brick sewer shall be built at one operation.

#### BRANCHES, MEASUREMENTS, ETC.

159. The construction of connections and branches for lateral sewers and receiving basins, and of openings and bulkheads and the measurement of brick sewers shall in all respects conform with the requirements hereinbefore specified for concrete sewers in sections 153 and 154.

#### PRICES TO COVER.

160. The contract prices for brick sewers shall cover the cost of all necessary excavation (except rock, when there is a contract price for rock excavation); of furnishing, placing, maintaining and removing all templates and centers; of all openings and bulkheads, also the removal of all bulkheads in the ends of sewers to which connection is made by the sewers in this contract; of all backfilling; of all embankments required; and of all labor and materials required to construct brick sewers as shown by the normal sections on the plan and as specified.

## VITRIFIED PIPE SEWERS.

### VITRIFIED PIPE.

161. Vitrified pipe sewers and house connections shall be built of shale or clay hub and spigot pipes with deep and wide sockets. The pipes shall be manufactured at a suitable temperature, to secure a tough, vitreous material, without warps, cracks or other imperfections, and shall be fully and smoothly salt-glazed over the entire inner and outer surfaces, except that the inside of the hub and the outside of the spigot may be unglazed for two-thirds of the depth of the hub. On all other portions of the pipe the glazing shall completely cover and form an integral part of the pipe body. If not left unglazed the inside of the hub and the outside of the spigot shall be scored in 3 parallel lines extending completely around the circumference.

When it is broken, vitrified pipe shall show dense and solid material, without detrimental cracks or laminations; it shall be of such toughness that it can be worked with a chisel and hammer, and when struck with a hammer, it shall have a metallic ring.

### IDENTIFICATION MARKS.

162. Each pipe shall have clearly impressed on its outer surface the name of the manufacturer and of the factory in which it was made.

### SHAPE AND DIMENSIONS.

163. The sizes of the pipes are designated by their interior diameters. Each pipe shall be a cylinder with a circular section, and shall have a uniform thickness.

164. The minimum lengths, thicknesses, depths of hubs and annular spaces for the respective sizes of vitrified pipes shall be as follows:

Size. inches.			Length. feet.	Thickness. inch.	Depth of socket. inches.	Annular space. inch.
6	not	less	than 2	$\frac{5}{8}$	$2\frac{1}{2}$	$\frac{5}{8}$
8	not	less	than 2	$\frac{3}{4}$	$2\frac{3}{4}$	$\frac{5}{8}$
10	not	less	than 2	$\frac{7}{8}$	$2\frac{3}{4}$	$\frac{5}{8}$
12	not	less	than 2	1	3	$\frac{5}{8}$
15	not	less	than 2	$1\frac{1}{4}$	3	$\frac{5}{8}$
18	not	less	than 2	$1\frac{1}{2}$	$3\frac{1}{4}$	$\frac{5}{8}$
20	not	less	than 2	1 2-3	$3\frac{1}{2}$	$\frac{5}{8}$
22	not	less	than 2	1 5-6	$3\frac{3}{4}$	$\frac{5}{8}$
24	not	less	than 2	2	4	$\frac{5}{8}$
27	not	less	than $2\frac{1}{2}$	$2\frac{1}{4}$	4	$\frac{3}{4}$
30	not	less	than $2\frac{1}{2}$	$2\frac{1}{2}$	4	$\frac{3}{4}$
33	not	less	than $2\frac{1}{2}$	$2\frac{5}{8}$	5	$1\frac{1}{4}$
36	not	less	than $2\frac{1}{2}$	$2\frac{3}{4}$	5	$1\frac{1}{4}$
42	not	less	than $2\frac{1}{2}$	$3\frac{1}{2}$	5	$1\frac{1}{4}$

#### CURVES, BENDS, ETC.

165. Where curved pipes are required they shall be furnished in either one-eighth or one-quarter bends of their respective sizes. Curved pipes, bends, siphons, and special pipe of the sizes and forms shown on the plan shall be furnished and laid, and unless otherwise provided they will be paid for at the contract prices for the corresponding sizes of vitrified pipe sewers.

#### SAMPLES FOR TESTING.

166. Any or all of the following tests may be applied to samples selected by the Engineer from the pipe delivered on the work. For the purpose of making such tests as may be required the Contractor shall furnish and deliver, when directed, and at the place required, one length of pipe for each 200 feet of pipe sewer to be laid.

#### CRUSHING TESTS.

167. When supported at the bottom upon a knife edge one inch in width in such manner that an even bearing is provided throughout the whole length, exclusive of the bell, and pressure is applied at the crown uniformly through a



similar knife edge, the various sizes of pipe shall withstand the following pressures:

Diameter. inches.	Pressure. lbs. per lin. ft.	Diameter. inches.	Pressure. lbs. per lin. ft.
6	900	22	1750
8	900	24	1950
10	1000	27	2150
12	1050	30	2350
15	1250	33	2500
18	1400	36	2800
20	1550	42	3200

#### DROP WEIGHT TEST.

168. When supported on a dry sand bed 2 inches deep, all pipe shall withstand without cracking the impact from 2 blows of a cast iron ball weighing 8 pounds falling 18 inches. Spurs shall resist without fracture the impact from 2 blows of such a ball falling 6 inches and striking on the extreme end of the hub of the spur.

#### HYDROSTATIC TEST.

169. When subjected to an internal hydrostatic pressure of 10 pounds per square inch, vitrified pipe shall show no percolation.

#### ABSORPTION TEST.

170. After having been thoroughly dried and then immersed in water for 24 hours, sample pieces of vitrified pipe about 10 square inches superficial area with all broken edges shall not absorb more than  $5\frac{1}{2}$  per cent. of their weight of water.

#### FACTORY REJECTION.

171. The entire product of any pipe factory may be rejected when, in the judgment of the Engineer, the methods of manufacture fail to guarantee uniform results, or where the materials used are such as produce inferior pipe, as indicated by repeated failure to comply with the tests herein specified.

### CRADLES.

172. In earth trenches pipe sewers shall be laid in concrete cradles when required by the plan. In rock trenches pipe sewers shall be laid in cradles of concrete, gravel or broken stone or sand as shown on the plan.

### WITHOUT CRADLE.

173. When the sewer is to be laid without a cradle the trench shall be excavated as specified in paragraph 15, and the earth forming the bed carefully freed of stones. The pipe shall then be evenly bedded therein, the joint properly made and the backfilling placed and firmly tamped in such a manner as to avoid disturbing the sewer.

### CONCRETE CRADLE.

174. When the sewer is to be laid in a concrete cradle, the method of procedure, otherwise directed or permitted, shall be as follows, viz: The concrete for the full width of the cradle shall be deposited continuously to the height of the outside bottom of the pipe. Before the concrete has set the pipe shall be evenly bedded therein and the remainder of the concrete immediately deposited and carefully tamped in such a manner as to avoid disturbing the sewer.

### GRAVEL OR BROKEN STONE CRADLE.

175. When the sewer is to be laid in a gravel or broken stone cradle, the latter shall consist of clean gravel or sound broken stone, all of which will pass through a 1-inch mesh, and be retained on a  $\frac{1}{8}$ -inch mesh screen. The gravel or broken stone shall be deposited and tamped for the full width of the trench to the height of the outside bottom of the pipe. The pipe shall then be bedded therein and the remainder of the gravel or broken stone deposited and carefully tamped in such a manner as to avoid disturbing the sewer.

### HOW LAID.

176. All pipes shall be laid with ends abutting and true to line and grade. The pipes shall be fitted together and matched so that when laid in the work they will form a sewer with a smooth and uniform invert. Unless otherwise permitted or directed, not less than ... feet of pipe sewer shall be laid in one operation.

177. Unless otherwise shown on the plan, the joints of vitrified pipe sewers shall be made as hereinafter specified in section 179.

### PLAIN MORTAR JOINTS.

178. Plain mortar joints shall be made in the following manner: Before a pipe is laid, the lower half of the hub of the preceding pipe shall be plastered on the inside with stiff mortar mixed 1 to 1, and of sufficient thickness to bring the inner bottoms of the abutting pipes flush and even. After the pipe is laid, the remainder of the hub shall be thoroughly filled with similar mortar and the joint wiped inside and finished to a smooth bevel outside.

### GASKET AND MORTAR JOINTS.

179. Gasket and mortar joints shall be made in the following manner: A closely twisted hemp or oakum gasket of suitable diameter, in no case less than  $\frac{3}{4}$  inch, and in one piece of sufficient length to pass around the pipe and lap at the top, shall be solidly rammed into the annular space between the pipes with a suitable calking tool. Before being placed, the gasket shall be saturated with neat cement grout. The remainder of the space shall then be completely filled with plastic mortar mixed 1 to 1 and the joint wiped inside and finished to a smooth bevel outside.

Joints for sanitary sewers and bituminous compound for same.

180. Joints of sanitary pipe sewers below the normal water table shall be made with a compound approved by the Chief Engineer. The compound shall preferably have a bi-

tuminous base, shall adhere firmly to the glazed surfaces of the pipes, shall melt and run freely at a temperature as low as 250° F. and when set shall be sufficiently elastic to permit of a slight movement of the pipes without injury to the joints or breaking the adhesion of the compound to the pipes. The compound shall not deteriorate when submerged in fresh or salt water or normal domestic sewage. It shall show no deterioration of any kind when immersed for a period of five days in a one per cent. solution of hydrochloric acid or a five per cent. solution of caustic potash.

All sanitary pipe sewers below the normal water table shall be laid in concrete cradles as shown on the plans; the joints shall be carefully centered and calked as specified in article 179. After a joint is properly calked, a suitable runner shall be placed and the compound, heated to a temperature of approximately 400° F., shall be poured into it in such a manner that the annular space shall be completely filled to within one-half inch of the outer rim of the bell of the pipe.

After the joints are run and the concrete cradle is placed those portions of the joints not embedded in the cradle shall be encased in cement mortar, which shall extend at least two inches from the face and outside of the bell. The cement mortar shall be mixed in the proportions of one part of cement to one of sand.

#### INSPECTION OF JOINTS.

181. Unless otherwise permitted, at least 4 finished joints shall be left exposed for inspection throughout the working day, and the necessary staging for the protection of the exposed sewers and for the handling of excavated material shall be provided. A suitable ladder affording easy access for such inspection shall be furnished at every trench open for the proposed sewer. The joints on the inside of all pipe sewers larger than 15 inches in diameter, shall be carefully filled with mortar and wiped smooth and flush with the surface of the pipe.

#### SUB-GRADE TO BE TESTED.

182. No pipe or the cradle therefor shall be laid or placed until the sub-grade of the trench shall have been tested and found correct.

#### SEWER TO BE KEPT CLEAN.

183. The interior of the sewer shall, as the work progresses, be cleared of all dirt, cement and superfluous materials of every description.

#### BACKFILLING.

184. Immediately after the sewer is laid the trench shall be backfilled as provided in sections 31, 32, 34, 35, 36, 37, 38 and 39. No walking on or working upon the completed sewer (except as may be necessary in tamping the backfilling) will be permitted until the trench has been backfilled to a height of at least 2 feet over the top of the sewer.

185. The exposed ends of pipe sewers shall be provided with approved temporary covers fitted to the pipe so as to exclude earth and other materials.

#### BRANCH PIPES.

186. Branch pipes and connection pipes shall be of the same quality and dimensions and laid in the same manner as specified for pipe sewers. Dead ends of pipes shall be closed with bulkheads of brick masonry 8 inches in thickness.

#### CONNECTION WITH EXISTING WORK.

187. Wherever the proposed sewer is to connect with an existing manhole in which there is a branch pipe which is damaged or of unsuitable size or in improper position, such pipe shall be removed and be replaced with a pipe of suitable size or be reset in the proper position. The pipe so substituted or reset will be paid for at the contract price for the corresponding size of pipe sewer.

#### PIPES CUT TO FIT MASONRY.

188. The ends of pipes which enter masonry shall be neatly cut to fit the face of the masonry. When directed, such cutting shall be done before the pipes are built in.

#### MEASUREMENT.

189. The length of pipe sewers to be paid for will be determined by measurements along their invert lines, and no deductions will be made on account of openings at man-holes.

#### PRICES TO COVER.

190. The contract prices for pipe sewers shall cover the cost of all necessary excavation (except rock when there is a contract price for rock excavation); of all sand, gravel, broken stone or concrete cradles required; of the making of all joints as specified; of all necessary trimming, fitting and building into masonry; of all bulkheads, also the removal of all bulkheads in the ends of sewers to which connection is made by the sewers in the contract; of all backfilling; of all embankments required; of all samples furnished; and of all labor and materials required to furnish and lay the sewers complete in place, as shown on the plan and as specified.

---

#### CEMENT CONCRETE PIPE SEWERS, WITHOUT RE-INFORCEMENT.

##### SHAPE AND DIMENSIONS.

191. Cement concrete pipes without re-inforcement, used in the construction of sewers, shall be hub and spigot pipes conforming in dimensions to the standard plan on file in the office of the Engineer. Variations not greater than one-half ( $\frac{1}{2}$ ) per cent. from such dimensions will be permitted.

192. Egg shaped sections for 12-inch and larger sizes shall have flat bases and shall be equal in quality to samples marked standard on exhibition at the Engineer's office.

#### QUALITY OF PIPE.

193. When cement concrete pipe is broken it shall appear homogeneous, be entirely free from cracks or voids and generally uniform, showing pieces of fractured stone, firmly imbedded in the mortar.

#### PROPORTIONS.

194. The concrete used in the manufacture of cement concrete pipe shall be composed of a mixture of the best quality of Portland cement, clean, sharp sand and clean, broken stone or gravel suitably graded and equal in quality to similar materials specified herein for concrete, and properly proportioned to produce a pipe that will comply with all the requirements specified in sections 195 to 202, inclusive.

#### METHOD OF MAKING.

195. Methods of molding, trimming and seasoning cement concrete pipe are left to the discretion of the manufacturer; as furnished, it shall be without warps, cracks or imperfections and shall present smooth inner and outer surfaces with no stones visible.

#### DELIVERY.

196. No pipe shall be delivered on the work or used within ... days after manufacture.

#### INSPECTION.

197. The materials used in the manufacture, the process of manufacture and the marking and dating of pipe shall be subject to inspection at the factory by inspectors designated by the Engineer.

#### DATE OF MOLDING.

198. All pipe shall have manufacturer's name and the date of molding clearly impressed on the outer surface as identification marks.

#### TESTS.

199. Sections 165, 166, 168, 169, 171, 172, 173, 174, relating to "curves, bends, etc.," "samples for testing," "drop weight tests," "hydrostatic pressure tests," "factory rejection," "cradles," "without cradles," "concrete cradles," and

all sections 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189 and 190, relating to manner of laying, jointing, inspection, etc., etc., of vitrified pipe sewers shall govern in the manufacture of cement concrete pipe and the construction of cement concrete pipe sewers, wherever applicable. Crushing tests shall be applied as in section 167, except that flat base of pipe shall rest on sand bed not less than 2 inches thick, and pressure through a knife edge one inch thick shall be applied at the crown.

#### SPURS AND BRANCHES.

200. The manner of forming and joining spurs and branches with hubs of standard dimensions to cement concrete pipe shall be such as to insure a tight union, of ample strength to meet the requirements of the work and of the tests heretofore specified for spurs and branches on vitrified pipe.

#### ABSORPTION TESTS.

201. After having been thoroughly dried and then immersed in water for 24 hours, sample pieces of cement concrete pipe of about ten square inches superficial area, with broken edges, shall not absorb more than ten (10) per cent. of their weight of water.

#### DIMENSIONS.

[Note—Sec. 202 was not adopted. An alternative section will be printed in the Proceedings of the Association for 1914 for discussion at the next convention.]

202. The minimum lengths, thicknesses, depths of hubs and annular spaces for the respective sizes of cement concrete pipes shall be as follows:

Diam- eter. inches.	Length. feet.	Thick- ness. inches.	Depth of socket. inches.	Annular space.	And as shown on Standard Plan.
6	2	$\frac{3}{4}$	$2\frac{1}{2}$	Not less than $\frac{5}{8}$ inch.	
8	3	$\frac{7}{8}$	$2\frac{1}{2}$	Not less than $\frac{5}{8}$ inch.	
10	3	1	$2\frac{5}{8}$	Not less than $\frac{5}{8}$ inch.	
12	3	$1\frac{1}{4}$	$2\frac{3}{4}$	Not less than $\frac{5}{8}$ inch.	
15	3	$1\frac{1}{2}$	$2\frac{3}{4}$	Not less than $\frac{5}{8}$ inch.	
18	3	$1\frac{3}{4}$	3	Not less than $\frac{3}{4}$ inch.	
20	3	2	3	Not less than $\frac{3}{4}$ inch.	
22	3	$2\frac{1}{4}$	$3\frac{1}{4}$	Not less than $\frac{3}{4}$ inch.	
24	3	$2\frac{1}{2}$	$3\frac{1}{4}$	Not less than 1 inch.	



## CEMENT CONCRETE PIPE SEWERS WITH REINFORCEMENT.

### SHAPE AND DIMENSION.

203. Reinforced cement concrete pipes used in the construction of sewers shall be either circular in section without flat base, or egg shaped in section with flat base, and shall conform in dimensions to the standard plan on file in the office of the Engineer. Variations not greater than one-half ( $\frac{1}{2}$ ) per cent. from such dimensions will be permitted.

### ENDS OF PIPES.

204. The ends of such pipes shall be molded with hubs and spigots or with any other shapes which are satisfactory to the Engineer, and which will permit the making of tight, smooth and permanent joints. The shapes of the pipe ends shall be such as to require and permit the making and finishing of the joints both on the inside and outside of the sewer.

205. The pipes shall conform to the requirements in section 193 and shall be equal in quality to samples marked "Standard" on exhibition at the Engineer's office.

### DIMENSIONS, ETC.

[Note—Section 206 was not adopted. See note under Sec. 202.]

206. The minimum lengths, thicknesses and depths of hubs for the respective sizes of re-inforced concrete pipes shall be as follows:

Size. inches.	Lengths. feet.	Thickness. inches.	Depth of Socket. inches.
24	4	3	3½
30	4	3½	4
36	4	4	4½
42	4	4½	5
48	4	5	6
54	4	5½	6
60	4	6	6
66	4	6½	6
72	4	7	6
78	4	8	6
84	4	8	6

#### TYPE OF REINFORCEMENT.

207. The steel used for reinforcement of cement concrete pipe shall conform to the requirements for such material specified in section No. 111.

a. It shall be either expanded metal, rods or wire mesh, equal in quality and design to that manufactured by the American Steel and Wire Company.

b. Where reinforcement in pipes is exposed, it shall be thoroughly painted with cement grout so as to prevent deterioration by exposure to the weather, unless the reinforcement be galvanized.

#### REINFORCEMENT FOR CIRCULAR PIPES.

208. In all sizes of circular reinforced cement concrete pipe from 24 inches to 48 inches diameter, inclusive, reinforcement shall be placed at distances varying from 1 inch to  $1\frac{1}{2}$  inches from the inner surfaces, according to diameter of pipes, as shown on the plan.

a. Either one or two lines of reinforcement may be used in the above sizes of pipes.

b. In all circular pipes whose diameters exceed 48 inches two lines of reinforcement shall be used, unless otherwise shown on the plan.

c. The inner line of reinforcement shall be placed two inches from the inner surface. The outer line of reinforcement shall be placed  $1\frac{3}{4}$  inches from the outer surfaces.

#### REINFORCEMENT FOR EGG SHAPE PIPE.

209. In all sizes of egg shaped reinforced cement concrete pipes, reinforcement shall be placed in such manner as to best resist stresses induced by external loads, and in a manner satisfactory to the Engineer. In all cases the shapes to which reinforcement shall be bent in the finished pipe shall be smooth and true, so that its position in the pipe shall conform at all points to that shown on the standard plan.

## SAMPLES FOR TESTING.

210. Any or all of the following tests may be applied to samples selected by the Engineer from the pipe delivered on the work. For the purpose of making such tests as may be required, the Contractor shall furnish and deliver, when directed, and at the place required, three lengths of each size of pipes used in the work.

## CRUSHING TESTS.

211. When tested in the manner described in Section No. 167, the various sizes of pipes between 24-inch and 42-inch in diameter, inclusive, shall withstand the following pressure:

When supported upon a saddle which extends the full length of the pipe exclusive of the bell and whose upper surface fits accurately the outer curved surface of the pipe, and whose width is equal to an arc of 15 degrees, in such a manner that an even bearing is provided throughout the whole length, and pressure is applied at the crown uniformly through a knife edge one inch in width, the various sizes of pipes with diameters greater than 42 inches shall withstand the following pressures:

Diameter. inches.	Pressure. lbs. per lin. ft.	Diameter. inches.	Pressure. lbs. per lin. ft.
24	1950	60	5000
30	2350	66	5500
36	2800	72	6000
42	3200	78	6500
48	3800	84	7000
54	4400		

212. Reinforced concrete pipe in which the reinforcement is not placed symmetrically about the circumference of the shell or in which only one concentric line of reinforcement is used, shall be tested in such a manner as to develop the same bending moments at the extremities of the vertical and horizontal diameters as will be developed at the crown by the tests specified above.

## HYDROSTATIC AND ABSORPTION TESTS.

213. When subjected to an internal hydrostatic pressure of ten (10) pounds per square inch, reinforced cement concrete pipe shall show no percolation.

Reinforced cement concrete pipe shall meet the requirements of the absorption test specified in Section 201.

214. Reinforced cement concrete pipes having openings to receive spur and branch connections shall be furnished and laid at such points as the Engineer may designate and as called for by the plan. The openings in pipes shall be made in accordance with a plan approved by the Chief Engineer, and the openings shall be such that connection may be made with the sewer in as effective a manner as is possible with pipes with molded spur connections.

## GENERAL.

215. All the sections relating to vitrified pipe sewers and to cement concrete pipe sewers without reinforcement which are pertinent and applicable to reinforced cement concrete pipe sewers unless otherwise specified herein shall govern in all respects and details.

---

## CAST IRON PIPE SEWERS.

### CAST IRON PIPE.

216. Cast iron pipe for sewers shall conform with the requirements of the latest revised Standard Specifications for Cast Iron Pipe adopted by the American Society for Testing Materials, and all tests required shall be made in accordance therewith.

217. The thickness of shell and weight of the several classes of pipe, and the allowable variations of diameter and weight shall be as follows:

Nominal Inside Diameter inches	Class A 100 foot Head 43 pounds Pressure		Class B 200 foot Head 80 pounds Pressure		Class C 300 foot Head 130 pounds Pressure		Allowable Variations	
	Thickness inches	Weight pounds	Thickness inches	Weight pounds	Thickness inches	Weight pounds	Diam. inches	Weight
4	0.42	240	0.45	260	0.48	280	0.06	5 p. c.
6	0.44	370	0.48	400	0.51	430	0.06	5 p. c.
8	0.46	515	0.51	570	0.56	625	0.06	5 p. c.
10	0.50	685	0.57	765	0.62	850	0.06	5 p. c.
12	0.54	870	0.62	985	0.68	1100	0.06	5 p. c.
14	0.57	1075	0.66	1230	0.74	1400	0.06	5 p. c.
16	0.60	1300	0.70	1500	0.80	1725	0.06	5 p. c.
18	0.64	1550	0.75	1800	0.87	2100	0.08	4 p. c.
20	0.67	1800	0.80	2100	0.92	2500	0.08	4 p. c.
24	0.76	2450	0.89	2800	1.04	3350	0.08	4 p. c.
30	0.88	3500	1.03	4000	1.20	4800	0.10	4 p. c.
36	0.99	4700	1.15	5450	1.36	6550	0.10	4 p. c.
42	1.10	6150	1.28	7100	1.54	8600	0.10	4 p. c.
48	1.26	8000	1.42	9000	1.71	10900	0.12	4 p. c.
54	1.35	9600	1.55	11200	1.90	13700	0.15	4 p. c.
60	1.39	11000	1.67	13250	2.00	16100	0.15	4 p. c.

The above weights are for 12 feet laying lengths and standard sockets; proportionate allowance will be made for any variation therefrom.

#### VARIATION IN THICKNESS.

218. For pipes whose standard thickness is less than 1 inch, the thickness of metal in the body of the pipe shall not be more than 0.08 inch less than the standard thickness; and for pipes whose standard thickness is 1 inch or more, the variation shall not exceed 0.10 inch, except that for areas not exceeding 8 inches in any direction, variations from the standard thickness of 0.02 inch in excess of the allowance above given will be permitted.

#### COATING.

219. All cast iron pipes shall be thoroughly and evenly coated inside and outside with coal tar pitch varnish. The coating shall be smooth, tough and tenacious when cold and shall not be brittle or have any tendency to scale off.

#### MARKING.

220. The weight and class letter shall be conspicuously painted by the manufacturer with white oil paint on the inside of each pipe after the coating is hard.

221. Joints of cast iron pipe sewers shall be of the kinds shown on the plan.

#### LEAD JOINTS.

222. When lead joints are required, the inner portion of the annular space between the pipes shall be packed with clean, sound jute packing yarn and the remaining portions shall be run full of pure, soft lead and calked with suitable tools. Unless otherwise shown on the plan, the depths of the lead joints shall be  $2\frac{1}{2}$  inches for 6-inch to 8-inch pipe; 3 inches for 12-inch to 24-inch pipe, and  $3\frac{1}{2}$  inches for 30-inch to 48-inch pipe.

#### MORTAR JOINTS.

223. When gasket and mortar joints or plain mortar joints are required they shall be made as specified in Sections 178 and 179.

224. All the requirements, as hereinbefore specified, relating to excavation, laying, backfilling and measurements of vitrified pipe sewers shall apply, as far as they are applicable, to cast iron pipe sewers.

#### PRICES TO COVER.

225. The contract prices for cast iron pipe sewers shall cover the cost of all necessary excavation (except rock when there is a contract price for rock excavation); of all sand, gravel, broken stone, or concrete cradles required; of the making of all joints; of all bulkheads; of all backfilling; of all embankments required and of all labor and materials required to furnish and lay the sewers complete in place, as shown on the plan and as specified.

---

#### BASIN CONNECTIONS.

226. The connections between receiving basins or inlet basins and sewers or manholes shall be of 12-inch vitrified pipe, unless otherwise shown on the plan. The pipes shall be of the same quality and dimensions and laid in the same manner as hereinbefore specified for vitrified pipe sewers.

#### MEASUREMENT.

227. The lengths of basin connections to be paid for will be determined by measurements along their inverts.

#### PRICE TO COVER.

228. The contract price for basin connections shall cover the cost of all necessary excavation (except rock, when there is a contract price for rock excavation); of all sand, gravel, broken stone, or concrete cradles required; of all necessary trimming, fitting and building into masonry; of all backfilling; of all embankments required; and of all labor and materials required to furnish and lay the basin connections complete in place, as specified.

#### PIPE DRAINS.

229. Pipe drains shall be built of vitrified or cement concrete pipe of the same quality and dimensions and laid in the same manner as hereinbefore specified for pipe sewers.

#### OLD DRAINS RESTORED OR EXTENDED.

230. Any existing drain encountered disturbed or removed on account of the work under this contract shall, if required, be restored or connected with the new work as directed. The portions of such drain restored or the extensions thereof will be paid for at the contract prices for pipe drains of the same size.

#### MEASUREMENT.

231. The lengths of pipe drains to be paid for will be determined by measurements along their inverts.

#### PRICES TO COVER.

232. The contract prices for pipe drains shall cover the cost of all necessary excavations (except rock, when there is a contract price for rock excavation); of all necessary trimming, fitting and building into masonry; of all backfilling; of all embankments required; and of all labor and materials required to furnish and lay the drains complete in place, as specified.

#### SPURS FOR HOUSE CONNECTIONS.

233. Spurs for house connections shall be of vitrified or cement concrete pipe 6 inches in diameter, equal in quality and dimensions to that specified for pipe sewers.

#### IN BRICK AND CONCRETE SEWERS.

234. In brick and concrete sewers spurs shall be built in as shown on the plan or as directed. They shall be hub and spigot pipes with the spigot end moulded or cut to fit flush with the inner surface of the sewer, and of sufficient length to reach the exterior of the sewer.

#### IN PIPE SEWERS.

235. Pipes having 6-inch spurs with hubs moulded thereon shall be furnished and laid in pipe sewers where shown on the plan or directed. The cost of such pipes shall be included in the contract prices for pipe sewers.

#### COVERS.

236. The ends of all spurs not connected with drains shall be closed with approved covers of the same material as the pipe. If required, such covers shall be cemented in place, and when directed the covers shall be so cemented before the pipes are lowered into the trench.

#### PRICE TO COVER.

237. The cost of spurs and all labor and materials required to furnish and place the same as specified, and furnishing and cementing the covers for the same, shall be included in the contract price of the sewers to which they connect. They shall be furnished and laid as above specified without extra cost to the city.

#### DRAINS FOR HOUSE CONNECTIONS.

238. Where shown on the plan or where directed, drains or house connections shall be built from the spurs in such a manner and for such distance as may be shown or directed.



#### DEPTH AT CURB.

239. Generally house connection drains shall be laid with such a gradient as to secure a depth at the curb line of  $9\frac{1}{2}$  feet or at a gradient of  $\frac{1}{4}$  inch per foot. Where this is not possible or advisable, the depth at the curb line shall be as shown on the plan.

#### MATERIAL.

240. Unless otherwise shown on the plan, drains for house connections shall be of pipe of the quality and dimensions specified for pipe sewers. The ends of the drains shall be closed with approved covers of the same material as the pipe.

#### HOW LAID.

241. All the requirements, as hereinbefore specified, relating to excavation, laying and backfilling of pipe sewers shall apply, as far as they are applicable, to drains for house connections.

#### MEASUREMENT.

242. The lengths of pipe drains for house connections to be paid for will be determined by measurement along their inverts.

They shall be measured from the hub of the spur attached to the drain, sewer or riser.

#### PRICE TO COVER.

243. The contract price for drains for house connections shall cover the cost of all necessary excavation (except rock, when there is a contract price for rock excavation); the cost of all backfilling; the cost of all covers, bends and specials required; of all sand, gravel, broken stone or concrete cradles; and the cost of all labor and materials required to furnish and lay the drains for house connections complete in place, as specified and as shown on the plan.

#### RISERS.

244. Where shown on the plan on where directed, risers for house connections shall be built from the spurs in such a

manner and to such height as may be shown on the plan or directed. Unless otherwise shown on the plan, they shall be of pipe of the quality and dimensions hereinbefore specified for pipe sewers. They shall be supported and surrounded by concrete as shown, and each shall be closed with an approved cover of the same material as the pipe.

#### MEASUREMENT.

245. The lengths of risers to be paid for will be determined by measurements along their axes. They shall be measured from the hub of the spur attached to the main sewer.

#### PRICE TO COVER.

246. The contract price for risers shall cover the cost of all necessary excavation (except rock, when there is a contract price for rock excavation); the cost of all concrete used in connection with the risers; the cost of all backfilling; the cost of all covers, bends, and specials required; and the cost of all labor and materials required to construct the risers complete in place, as specified.

---

#### MANHOLES.

247. The masonry or concrete for manholes shall be built to within ... inches of the established grade of the street or to within ... inches of the existing surface of the ground, as directed. When not built up to within ... inches of the established grade of the street, the masonry or concrete shall, if directed, be covered with stone slabs not less than 5 inches thick or with an approved re-inforced concrete slab to support the head.

#### BRICK MANHOLES.

248. Brick manholes shall be formed by means of templates placed at top and bottom with not less than 8 lines drawn between them if directed by the Engineer, and they shall be smoothly and evenly plastered on the outside with a layer of mortar  $\frac{1}{2}$  inch thick.

#### CONCRETE MANHOLES.

249. Concrete manholes shall be built of the materials, sizes and dimensions shown on the plan.

#### STEPS.

250. Galvanized wrought iron steps of the size and shape shown on the plan shall be firmly built into the manholes at vertical intervals of about 16 inches.

#### HEAD AND COVER.

251. Manhole heads and covers shall be of cast iron, and unless otherwise shown on the plan, each head, exclusive of cover, shall weigh not less than 475 pounds and each cover shall weigh not less than 135 pounds. The weight of each head and cover shall be conspicuously painted thereon by the manufacturer with white oil paint. The head shall be set on the masonry or concrete in a full bed of stiff mortar.

#### DUST PANS, ETC.

252. Where shown on the plan, dust pans and protective gratings of the materials, forms and dimensions shown shall be furnished and fitted in the manholes.

#### PRICE TO COVER.

253. The contract price for manholes shall cover the cost of all necessary excavation (except rock, when there is a contract price for rock excavation); of all backfilling; of all plastering; of all stone and concrete slabs; of all steps; of heads and covers; of dust pans and protective gratings, when required; and of all labor and materials required to construct the same complete, in place, as shown on the plan and specified.

#### RECEIVING BASINS.

##### BRICK BASINS.

254. Brick receiving basins shall be built in the manner and of the dimensions shown on the plan. They shall be equipped with heads and hoods or traps corresponding with

the standard plan on file in the office of the Engineer. They shall be formed by means of templets placed at top and bottom with not less than 10 vertical lines drawn between them, if directed by the Engineer. If required, the outlets of receiving basins shall be closed with bulkheads of brick masonry and such bulkheads shall be removed when directed. The outside of the brickwork shall be smoothly and evenly plastered with a layer of mortar  $\frac{1}{2}$  inch thick.

#### CONCRETE BASINS.

255. Concrete receiving basins shall be built in the manner and of the dimensions shown on the plan. Class A concrete shall be used throughout and shall be placed for both bottom and side walls at one operation.

#### CONCRETE HEADS.

256. Where concrete heads or cover slabs of receiving basins or their inlets are built in or adjoin concrete sidewalks, the new work shall be made to correspond in pattern and color with the existing sidewalk.

#### PAVEMENT AT INLETS TO RECEIVING BASINS.

257. The pavements adjoining the inlets to receiving basins shall be restored and adjusted to the extent and in the manner directed, and in accordance with paragraphs ... and ... in unpaved streets and in macadamized streets, where the inlets to the receiving basins are approximately at the surface of the street, a space of  $2\frac{1}{2}$  feet adjoining such inlets shall, if required, be paved with approved paving blocks.

#### PRICE TO COVER.

258. The contract price for receiving basins shall cover the cost of all necessary excavation (except rock, when there is a contract price for rock excavation); of heads and inlets, traps and fittings; of the outlet culvert connecting with the sewer; of all backfilling; of all pavement required at the inlets to the basins; of the temporary brick bulkheads in the

outlets of the basins or outlet culverts when required; and of all labor and materials required to construct the receiving basins complete in place, as shown on the plan and specified.

---

#### STORM WATER INLETS.

259. Storm water inlets and the heads and covers therefor shall be of the materials, forms and dimensions shown on the plan. If required, the mouth of inlets shall be closed with bulkheads of brick masonry and such bulkheads shall be removed when directed.

#### PRICE TO COVER.

260. The contract price for inlets shall cover the cost of all necessary excavation (except rock, when there is a contract price for rock excavation); of all backfilling; of connections with sewers or basins; of the temporary brick bulkheads in the mouths of the inlets when required; and of all labor and materials required to construct the inlets complete, in place, as shown on the plan and specified.

#### FLUSH TANKS.

261. Flush tanks shall be of the materials, form and dimensions shown on the plan. Unless otherwise directed, they shall be connected with the water main and with the sewer. The connection with the water main shall be made under a permit from the proper authorities, and under their rules and inspection.

#### PRICE TO COVER.

262. The contract price for flush tanks shall cover the cost of all necessary excavation (except rock, when there is a contract price for rock excavation); of all backfilling; and of all labor and materials required to construct the flush tanks complete, in place, as shown on the plan, and to connect the same with the water main and the sewer.

## EMBANKMENT.

### QUALITY.

263. Where indicated on the plan, embankment shall be made of the form and dimensions shown. It shall consist of clean steam ashes, or filling of the quality specified in Sections 31, 32 and 34, which shall contain no stone over 6 inches in its largest dimension. When the material forming the embankment contains stones, the latter shall be so distributed through the mass that all interstices are filled with fine material, and the material within 2 feet of the sewer shall be free of stones. When embankment is used as foundation it shall consist entirely of filling of the quality specified in Sections 31 and 32.

### HOW MADE.

264. The embankment shall be deposited and spread in horizontal layers to such an extent and at such times as may be directed. When embankment is used as a foundation, the ground on which it is to be made shall be prepared by grubbing and clearing, and removing all improper material. Embankment used as foundation shall be deposited in uniform horizontal layers not exceeding 1 foot in depth, and each layer shall be thoroughly compacted by rolling or tamping, or both; such embankment shall not be built upon until the expiration of ... days after its completion.

### APPROACHES.

265. Where the embankment obstructs or interferes in any way with any public or private roadway, the Contractor shall furnish and place all material necessary to provide suitable approaches of such widths and to such extent as shown on the plan, or as directed.

266. All embankments and approaches shall be maintained at their full dimensions until the completion of this contract.

### PRICE TO COVER.

267. The cost of all labor and materials required to prepare the ground, to make the embankment and approaches as

specified, to make all necessary excavations and backfilling therein, and to maintain the embankments and approaches at their designated dimensions until the completion of this contract, shall be covered by the contract prices for the structures over or in connection with which they are made.

---

#### SLOPE PAVEMENT.

##### How LAID.

268. Slope pavement shall be not less than 18 inches in depth and shall be composed of sound quarried or split stones. Except when used for pinning or wedging, the stones shall be not less than 6 inches thick and from 12 to 18 inches long. They shall be placed by hand so as to present a fairly even surface, and have their longest dimensions approximately perpendicular to the side of the embankment. At least one-third of the stones shall extend through the pavement. Slope pavement will be measured by its superficial area.

##### PRICE TO COVER.

269. The contract price for slope pavement shall cover the cost of all labor and materials required to lay the same complete, in place, as specified.

---

#### RESTORATION OF SURFACE AND CLEANING UP.

##### RESTORATION OF UNPAVED ROADWAYS, SIDEWALKS, ETC.

270. At such time as may be directed, all unpaved roadways, gutters, and sidewalks affected by the work done under this contract shall be restored by the Contractor to the same condition in which they were at the time of the opening of bids for this contract.

##### PAVEMENTS, ETC., RESTORED BY CITY.

271. Unless otherwise required by the plan, all roadway and sidewalk pavements, cross-walks, curbs, etc., along the line of the work (except those under guarantee for mainte-

nance by the paving Contractor), which are removed, destroyed, lost or injured on account of, or during the construction of the work under this contract, or which are injured by traffic on account of any act or omission on the part of the Contractor, his agents, servants or employes, in the prosecution of the work, will be restored and adjusted by the city at the expense of the Contractor. For this purpose, before the completion of the contract, and when directed, the Contractor shall pay to the city a sum of money sufficient to cover the cost of restoring and adjusting the pavements, cross-walks, curbs, etc., the amount of the work to be done being determined by the Engineer, and the cost being computed at the following prices:

Granite block with concrete foundation, tar and gravel (or cement grout) joints.....	\$ per sq. yd.
Granite block pavement, with sand foundation.....	
Medina block pavement, with concrete foundation (grouted joints) .....	
Brick pavement with concrete foundation.....	
Brick pavement, with sand foundation.....	
Belgian block pavement.....	
Cobble stone pavement.....	
Macadam pavement .....	
Iron slag pavement.....	
Wood block pavement.....	
Asphalt block pavement over 10 yds.....	
Asphalt block pavement under 10 yds.....	
Sheet asphalt pavement, with concrete foundation, over 10 yds.	
Sheet asphalt pavement, with concrete foundation, under 10 yds.....	
Asphalt pavement, without concrete foundation, over 10 yds..	
Asphalt pavement, without concrete foundation, under 10 yds.	
Cement sidewalk relaid.....	\$ per sq. ft.
New flagging .....	
Flagging relaid .....	
Curbstone reset, sand foundation.....	\$ per lin. ft.
Curbstone reset, concrete foundation.....	
New curbstone furnished and set, sand foundation.....	
New curbstone furnished and set, concrete foundation.....	
Bridgestone reset, sand foundation.....	\$ per sq. ft.
Bridgestone reset, concrete foundation.....	
New bridgestone furnished and set, sand foundation.....	
New bridgestone furnished and set, concrete foundation.....	



#### PAVEMENTS, ETC., RESTORED BY CONTRACTOR.

272. If required by the plan, roadway and sidewalk, pavements, cross-walks, curbs, etc., except those under guarantee for maintenance, shall be satisfactorily restored and adjusted by the Contractor at such times as may be directed. Sidewalk pavements shall be restored in whole flags, squares or sections which shall correspond in quality and appearance with the original or adjoining flags, squares or sections. All work and materials used in such restoration and adjustment shall conform in all respects to the standard specifications now in use by the city for similar work and materials.

#### PAVEMENTS, ETC., UNDER GUARANTEE.

273. All pavements, sidewalks, cross-walks, curbs, etc., existing at the time of the opening of the bids for this contract, and under guarantee for maintenance, shall be restored and adjusted by the parties responsible under such guarantee, and at the expense of the Contractor. If not so restored and adjusted during the progress of the work, the Contractor shall, when directed, pay to the city, before the completion of the contract, a sum of money sufficient to cover the cost of having the same restored and adjusted by the parties responsible under such guarantee, and at the charges for the restoration of the same, as set forth in their contracts relating thereto. Such sum shall be accompanied by certificates from the parties responsible for the maintenance of the pavements, sidewalks, cross-walks, curbs, etc., to the effect that such sum will be accepted by them as covering the entire quantity of pavement, etc., to be restored and adjusted.

#### TEMPORARY RESTORATION.

274. At such times as may be directed roadway and sidewalk pavements, cross-walks, curbs, etc., which have been removed, whether under guarantee or not, shall be temporarily restored by the Contractor to the satisfaction of the Engineer.

#### CHANGE OF PAVEMENT, ETC.

275. When the kinds of pavements, sidewalks, cross-walks, curbs, etc., in any street affected by this contract, are changed after the bids are opened and before work is commenced, the Contractor will not be required to make permanent restoration of the new pavement, sidewalks, cross-walks, curbs etc., disturbed, but a sum of money sufficient to pay the cost of replacing the kinds of pavement, sidewalks, cross-walks, curbs, etc., which were there at the time of the opening of the bids for this contract, will be deducted from the amount which would have been payable to the Contractor upon the completion of the contract, had the character of pavements, etc., not been changed, and such cost will be computed at the prices stated in section 269.

#### WHEN NEW PAVEMENT IS LAID.

276. If pavement, sidewalks, cross-walks, curbs, etc., are laid where none existed at the time the bids for this contract were opened, the Contractor shall excavate and remove such portions of the pavements, sidewalks, cross-walks, curbs, etc., and their foundations as may be necessary for the prosecution of the work, but he will not be required to make a permanent restoration of them.

#### TRENCHES FLOODED.

277. Before laying any pavements, sidewalks, cross-walks, curbs, etc., the trenches shall, if required, be flooded with water, as directed, and all resulting holes or depressions shall be filled and tamped solid.

#### UNNECESSARY CROSS GUTTERS.

278. All cross gutters rendered unnecessary by the work under this contract shall be removed and the entire street intersection or so much thereof as may be necessary shall be regraded and re-paved as herein specified.

### CLEANING-UP.

279. At such times as may be directed, the Contractor shall remove from the streets all materials which were placed thereon by him as a consequence of performing this work, and which are not required by the contract to be left as part of the finished work. The entire work and portions of the street affected thereby shall be left in a satisfactory condition. The sidewalks and cross-walks shall be swept clean of all material which may have accumulated thereon by reason of the work performed under this contract, and if required, they shall be sprinkled with water during the sweeping.

### PRICES TO COVER.

280. The cost of all the labor required to be done and all the materials required to be furnished in the performance of all the work specified in Sections . . . , inclusive, shall be covered by all the contract prices for all the items for which there are contract prices.

-----  
[Proposed substitute for Art. 207.]

### PARAGRAPH ON DIMENSIONS AND REINFORCEMENT.

Reinforced concrete pipes shall have the following general dimensions and details.

Size.	Min. Length.	Min. Thickness.
24	4 feet	2½ inches
30	4 feet	2¾ inches
36	4 feet	3 inches
42	4 feet	3½ inches
48	4 feet	4 inches
54	4 feet	4½ inches
60	4 feet	5 inches
66	4 feet	5¼ inches
72	4 feet	5½ inches
78	4 feet	5¾ inches
84	4 feet	6 inches

The depth and details of socket and spigot ends shall be such as to insure a water tight joint and shall meet the approval of the Engineer.

Reinforcement shall consist of wires, rods, expanded metal or other standard reinforcement material and shall be so disposed as to efficiently reinforce the pipe when laid, at all points, in a manner satisfactory to the Engineer. In general there shall be a clearance between the reinforcement and the surface of the pipe at least equal to the diameter of the bar and never less than  $\frac{3}{4}$ -inch.

---

[Proposed Substitute for Art. 212.]

#### CRUSHING TESTS.

The standard crushing requirements shall be the ability of the pipe to withstand a load equivalent to the vertical weight of backfilling in a trench 20 feet deep, on the assumption that the pipe will not have lateral support. For damp yellow clay these loads are assumed to be as follows when supported as an evenly distributed load over full width of the pipe and the pipe is supported equally throughout the 180 degrees of invert without lateral support:

24—	3,350 lbs. per lin. ft. pipe
30—	4,400 lbs. per lin. ft. pipe
36—	4,800 lbs. per lin. ft. pipe
42—	5,600 lbs. per lin. ft. pipe
48—	6,600 lbs. per lin. ft. pipe
54—	7,500 lbs. per lin. ft. pipe
60—	8,000 lbs. per lin. ft. pipe
66—	8,800 lbs. per lin. ft. pipe
72—	9,400 lbs. per lin. ft. pipe
78—	10,000 lbs. per lin. ft. pipe
84—	10,400 lbs. per lin. ft. pipe

Should it be considered too difficult to make the loadings on the full diameter as described, the tests may be made by distributing a load evenly over a sand box area of 45 degrees on each side of the upper center line, and supporting the pipe and load upon an equal sand area at the bottom. In this case in order to produce bending moments at the crown which would be produced by the above standard loads, the loads shall be according to the following schedule:

24—	2,600 lbs. per lin. ft. pipe
30—	3,400 lbs. per lin. ft. pipe
36—	3,700 lbs. per lin. ft. pipe
42—	4,300 lbs. per lin. ft. pipe
48—	5,100 lbs. per lin. ft. pipe
54—	5,800 lbs. per lin. ft. pipe
60—	6,200 lbs. per lin. ft. pipe
66—	6,800 lbs. per lin. ft. pipe
72—	7,300 lbs. per lin. ft. pipe
78—	7,700 lbs. per lin. ft. pipe
84—	8,000 lbs. per lin. ft. pipe

In this case, however, since the load produces a less bending moment at the horizontal points or springing lines than when the standard load is applied over the full width of the pipe, or as it is in actual trench condition, the springing line of the pipe when analyzed as a reinforced concrete section shall have enough reinforcement along and near the outer surface of the ring to give a calculated moment of resistance equal at least to nine-tenths of the calculated moment of resistance at the top and bottom points.

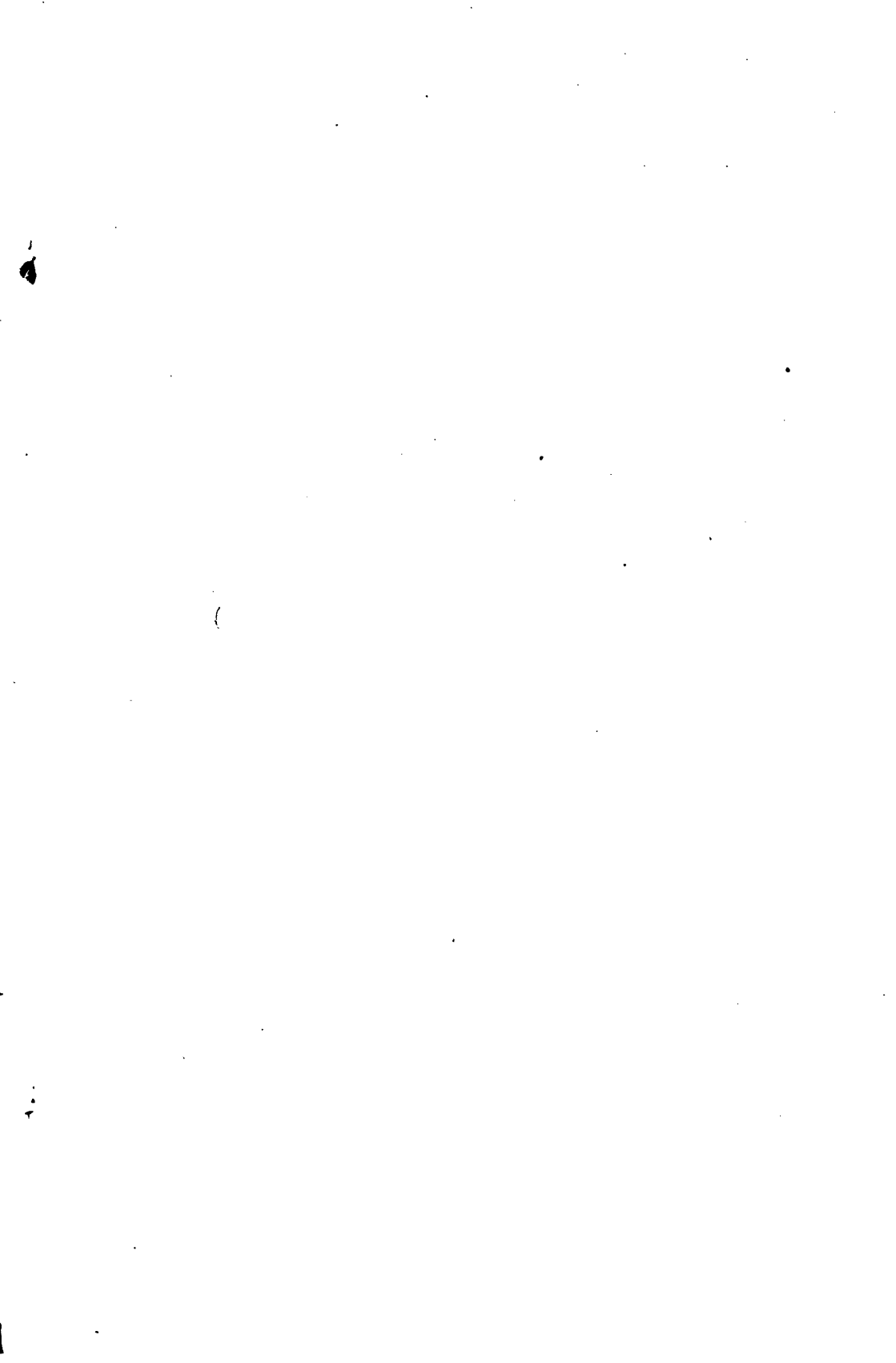
Should the Engineer prefer to use concentrated load tests by applying the load along knife edge bearing and supporting the pipe upon similar bearing at the base, as described in section 162, then the loads which the pipe shall sustain shall be as follows:

24	—1,350 lbs. per lin. ft. pipe
30	—1,750 lbs. per lin. ft. pipe
36	—1,900 lbs. per lin. ft. pipe
42	—2,200 lbs. per lin. ft. pipe
48	—2,600 lbs. per lin. ft. pipe
54	—3,000 lbs. per lin. ft. pipe
60	—3,200 lbs. per lin. ft. pipe
66	—3,500 lbs. per lin. ft. pipe
72	—3,700 lbs. per lin. ft. pipe
78	—4,000 lbs. per lin. ft. pipe
84	—4,100 lbs. per lin. ft. pipe

In this case the strength of the pipe, or its resistance against widening at the horizontal diameter shall be tested by calculation and in comparison with the calculated strength of the ring at the top and bottom shall conform to the requirements described in the preceding paragraph for tests with 90 degree distribution of vertical load.









**UNIVERSITY OF CALIFORNIA LIBRARY  
BERKELEY**

**Return to desk from which borrowed.**

**This book is DUE on the last date stamped below.**

**LIBRARY USE  
FEB 6 1953**

**LD 21-100m-7,'52 (A2528s16)476**

342986

TD678  
A5

Ames,

UNIVERSITY OF CALIFORNIA LIBRARY

